Washington State
Tuberculosis Epidemiologic Profile
2004

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EXECUTIVE SUMMARY

The Washington State Tuberculosis (TB) Epidemiologic Profile provides analysis and description of the TB disease burden in the state: incidence rates and relative risks for disease are calculated, disease distribution in sub-populations is described, risk factors are reported, and trends in TB are examined.

In 2004, Washington State reported 244 new cases of tuberculosis for a case rate of 3.9 per 100,000 persons, the lowest rate ever recorded in Washington. Nineteen of 39 counties had at least one new case of TB. There were seven counties with five or more cases of TB. Among these, the five highest county-specific incidence rates were King (7.4), Island (6.6), Yakima (5.2), Pierce (4.5), and Whatcom (3.3).

The difference between gender-specific incidence rates did not reach statistical significance in 2004 (4.6 per 100,000 in males, 3.2 per 100,000 in females). Persons 65 years of age and older had the highest age-specific incidence rate, 7.3 per 100,000 population. Tuberculosis disproportionately affects minority populations: Asians had the highest incidence rate (24.0), followed by blacks (22.5), American Indians (12.5) and Hispanics (6.18). Sixty-seven percent of all cases of TB in 2004 were in persons born outside the United States. The largest proportion of foreign-born cases were from Vietnam (n=30), the Philippines (n=23), Mexico (n=18), South Korea (n=15), and Ethiopia (n=13).

In 2004, nine (4%) cases were diagnosed while living in a correctional facility; seven (3%) residents of long-term care facilities were also diagnosed with TB. Nineteen (8%) cases had a previous episode of active tuberculosis and 43% were considered unemployed when diagnosed. Co-morbidity with HIV/AIDS remains low in Washington State; only 4% of all TB cases were co-infected with HIV. Drug resistance was found in 33 (16%) of the 203 culture positive cases that had sensitivity testing done in 2004. Eighteen cases were resistant to Isoniazid (INH). There were two Multi-Drug Resistant (MDR-TB) cases in 2004 and one Rifampin-only resistant case as compared to none in 2003.

In 2002, an outbreak of TB was discovered among the homeless population in King County. A detailed description of the outbreak as of January 2005 is provided in Appendix 1 of this profile. In 2004, an East African outbreak was discovered in King County. A description of the outbreak as of January 2005 is provided in Appendix 2 of this profile.

TUBERCULOSIS IN THE UNITED STATES

2004 National Highlights

After more than a decade of falling incidence rates, the rate of decline for persons with active TB in the United States is slowing. New surveillance data for 2004 show that 14,511 persons with active TB disease were reported in the United States, comparable to the 14,871 cases reported in 2003. In 2004, the national case rate for TB was 4.9 cases per 100,000 population, a slight decline of 3.3% in case rate since 2003. 2003 and 2004 reported the smallest one-year declines in incidence rates since 1992 (2.3% in 2003 and 3.3% in 2004).

During 2004, a total of 30 (58.8%) states reported a decline in cases from 2003. Seventeen states and DC reported an increase in cases, and three states reported the same number of cases as in 2003. Seven states reported more than 400 cases each in 2004; collectively these states accounted for 8,689 cases, or 59.9% of the national case total. Of these seven states, two reported increases for 2004 (Texas, 4.0% and Florida, 1.0%); the other five states reported decreases (California, 8.4%; Georgia, 2.5%; Illinois, 10.9%; New Jersey, 3.3%; and New York, 7.3%).[1]

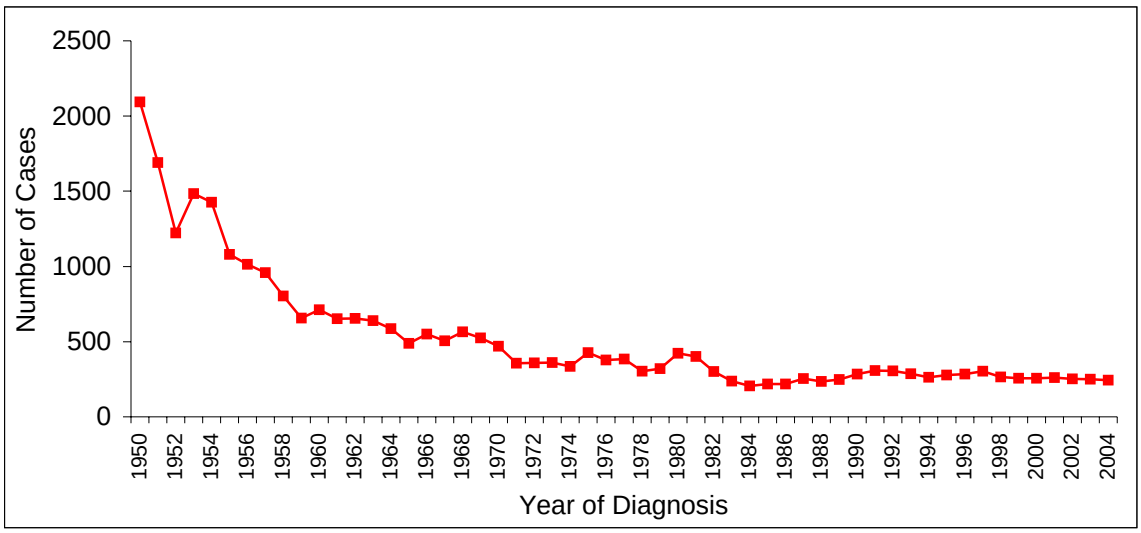
In contrast to the substantial decline in cases among U.S.-born persons since 1993, the number of cases reported among foreign-born persons has not changed substantially. From 1996 to 2000, the TB rate for foreign-born persons decreased 22.4%, from 32.6 to 25.3; from 2000 to 2004, the rate decreased 11.2%, from 25.3 to 22.5. During these periods, the growth of the foreign-born population in the United States ranged from a 26.6% increase during 1996-2000 to a 14.2% increase during 2000-2004.

In 2004, for the first time, TB was reported more frequently among Hispanics than among any other racial/ethnic population. The number of cases in Hispanics increased 1.2%, from 4,109 in 2003 to 4,160 in 2004. However, the TB rate for Hispanics decreased, from 10.3 in 2003 to 10.1 in 2004. The increase in case counts, but decrease in rates, reflects a 3.6% increase in the 2004 U.S. population of Hispanics compared with 2003. For blacks, whites, and Asians, the case numbers and rates both decreased. Of 3,221 Asians with TB and known origin of birth, 3,074 (95.4%) were foreign born; of 4,105 Hispanics with TB, 3,037 (74.0%) were foreign born; and, of 3,981 blacks with TB, 1,055 (26.5%) were foreign born.

[1] Morbidity and Mortality Weekly Report (MMWR). Trends In Tuberculosis – United States, 2004. Morbidity and Mortality Weekly Report (MMWR), March 18, 2005 / 54(10);245-249.

TUBERCULOSIS IN WASHINGTON STATE

Figure 1
Tuberculosis Morbidity in Washington, 1950-2004



Fifteen-Year State Trends

- The number of TB cases in Washington increased 25% from 1989-1991 and decreased 15% from 1991-1994. After a period of increased cases (1995-1997) the case count has declined 20% (Figure 1).
- The TB incidence rate increased 22% from 1989-1991 and decreased 62% from 1991-2004 (Figure 3). Nationally, the TB incidence rate peaked in 1992 with 10.5 cases per 100,000 and decreased 53% to 4.9 per 100,000 in 2004 – the lowest national rate to date (Figure 3). Overall, the trend in Washington's incidence rate reflects the national trend.

Figure 2
Number of Tuberculosis cases in Washington, 1989-2004

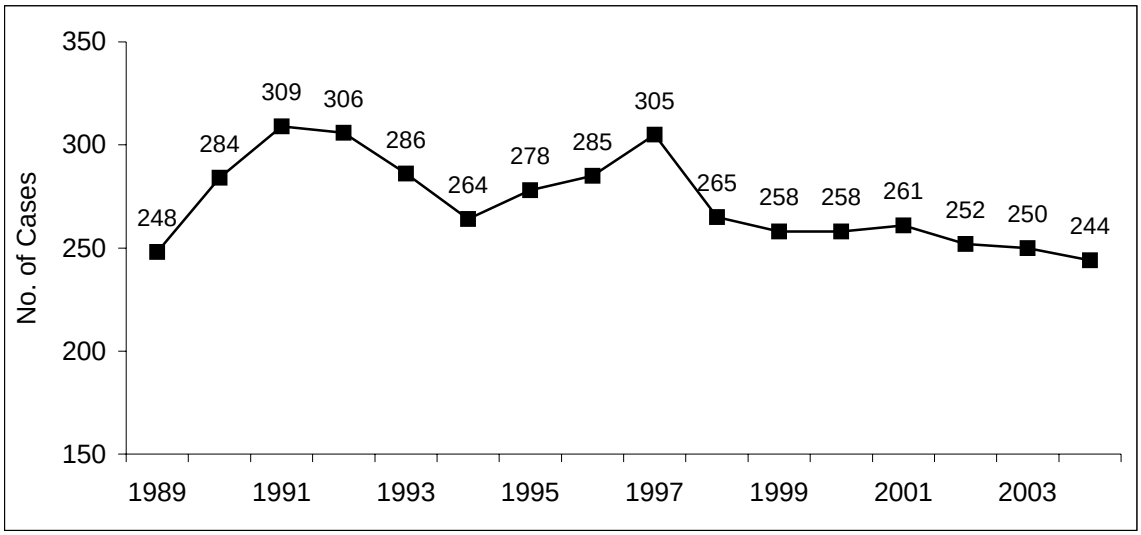
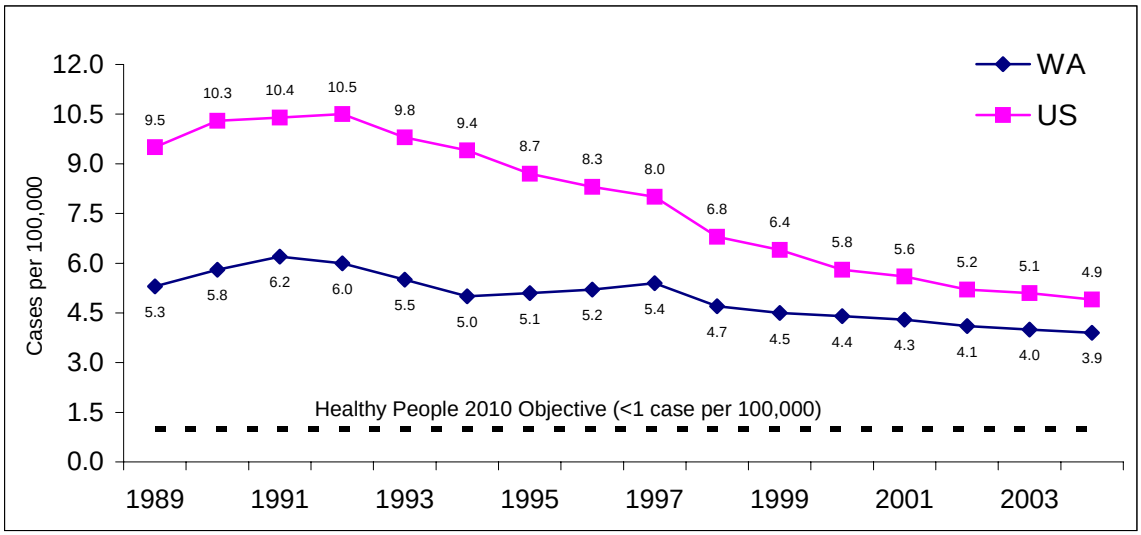


Figure 3
Tuberculosis incidence rates in Washington, 1989-2004



County Level Distribution

2004 Highlights

- There were 244 new cases of active TB in 2004.
- The TB incidence rate was 3.9 per 100,000 persons in 2004 – the lowest incidence rate recorded in Washington State. Nationally, the TB incidence rate was 4.9 per 100,000, marking a continued decrease in incidence rates since 1992 (Figure 3).
- Nineteen of 39 counties reported at least one new case, a decrease of ten counties not reporting any TB cases since 2003 (Table 1).

- King County reported the highest number of cases (133), followed by Pierce (34), Snohomish (15), Yakima (12), and Clark (8) counties (Table 1). Eighty-three percent of all cases occurred among these five counties while 55% occurred in King County.
- The incidence rate in King County was 7.4 per 100,000 (high); the combined incidence rate among Clark, Island, Pierce, Snohomish, Thurston, Whatcom, and Yakima counties was 2.9 (medium); all other counties had a combined incidence rate of 1.6 per 100,000 (low) (Table 1).

Table 1
Tuberculosis cases and incidence rates by county in Washington, 2004

	No.	Rate		No.	Rate
Adams	0	-	Lewis	1	-
Asotin	0	-	Lincoln	0	-
Benton	4	-	Mason	1	-
Chelan	0	-	Okanogan	0	-
Clallam	0	-	Pacific	0	-
Clark	*8*	*2.0*	Pend Oreille	0	-
Columbia	0	-	*Pierce*	*34*	*4.5*
Cowlitz	0	-	San Juan	1	-
Douglas	0	-	Skagit	2	-
Ferry	0	-	Skamania	0	-
Franklin	3	-	*Snohomish*	*15*	*2.3*
Garfield	0	-	*Spokane*	*7*	*1.6*
Grant	0	-	Stevens	0	-
Grays Harbor	1	-	*Thurston*	*7*	*3.2*
Island	*5*	*6.6*	Wahkiakum	0	-
Jefferson	0	-	Walla Walla	1	-
King	*133*	*7.4*	*Whatcom*	*6*	*3.3*
Kitsap	2	-	Whitman	0	-
Kittitas	1	-	*Yakima*	*12*	*5.2*
Klickitat	0	-	**State Total**	**244**	**3.9**

Note: rates not calculated for cell sizes < 5.

Five-Year County Trends

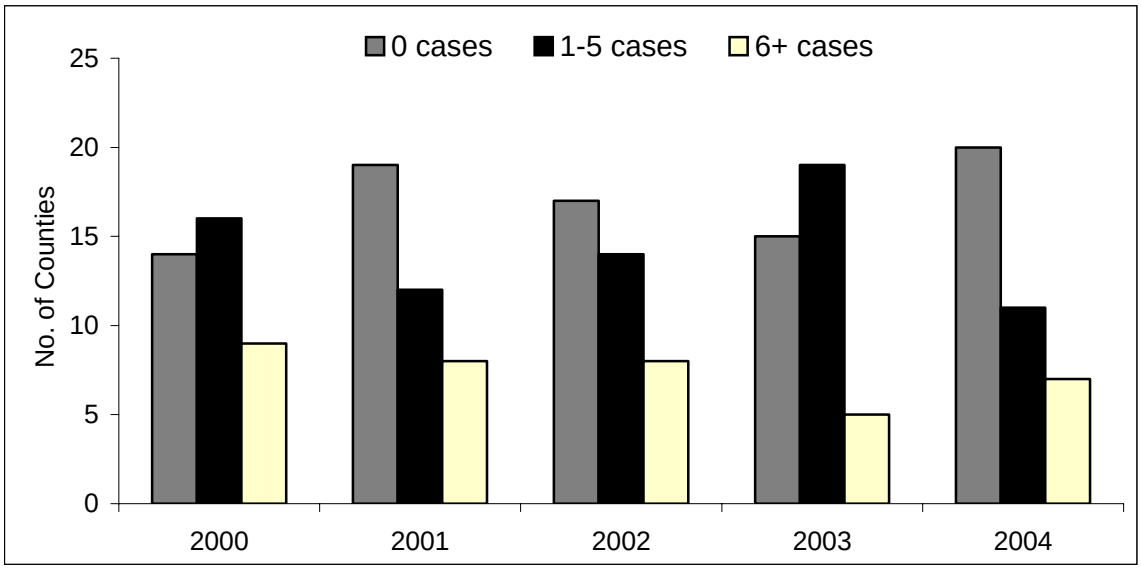
- From 2000-2004, most counties in Washington reported few cases of TB. Twenty counties reported fewer than five cases during this time period (Table 2). In 2004, Washington saw a decrease in the number of counties reporting cases as compared with 2003 (19 vs. 24 counties, respectively) (Figure 4).
- Ferry, Garfield, Lincoln, Pend Oreille, Stevens, and Wahkiakum counties have not reported a case of tuberculosis in the last five years.
- Only five counties had five or more cases of TB per year from 2000-2004: Clark, King, Pierce, Snohomish, and Yakima (Table 2).

Table 2
Tuberculosis cases by county in Washington, 2000-2004

	2000		2001		2002		2003		2004	
County	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Adams	1	-	0	-	0	-	1	-	0	-
Asotin	0	-	0	-	0	-	0	-	0	-
Benton	3	-	1	-	1	-	2	-	4	-
Chelan	0	-	1	-	1	-	4	-	0	-
Clallam	2	-	0	-	0	-	1	-	0	-
Clark	6	1.8	8	2.2	10	2.7	10	2.6	8	2.0
Columbia	0	-	0	-	0	-	0	-	0	-
Cowlitz	6	6.3	2	-	2	-	1	-	0	-
Douglas	1	-	0	-	1	-	2	-	0	-
Franklin	6	13.2	2	-	3	-	5	9.3	3	-
Grant	3		7	9.9	2	-	3	-	0	-
Grays Harbor	1	-	3	-	1	-	1	-	1	-
Island	0	-	1	-	0	-	1	-	5	6.6
Jefferson	1	-	0	-	0	-	0	-	0	-
King	127	7.5	138	7.9	158	8.9	155	8.7	133	7.4
Kitsap	7	3.0	5	2.1	6	2.5	2	-	2	-
Kittitas	0	-	1	-	0	-	0	-	1	-
Klickitat	1	-	0	-	1	-	0	-	0	-
Lewis	2	-	0	-	0	-	2	-	1	-
Mason	1	-	4	-	0	-	3	-	1	-
Okanogan	2	-	0	-	1	-	2	-	0	-
Pacific	0	-	0	-	0	-	0	-	0	-
Pierce	34	4.8	22	3.0	16	2.2	18	2.4	34	4.5
San Juan	1	-	0	-	1	-	0	-	1	-
Skagit	0	-	1	-	3	-	2	-	2	-
Skamania	0	-	0	-	0	-	0	-	0	-
Snohomish	21	3.6	28	4.5	16	2.5	12	1.8	15	2.3
Spokane	14	3.4	10	2.3	7	1.6	4	-	7	1.6
Thurston	2	-	5	2.3	3	-	5	2.3	7	3.2
Walla Walla	2	-	1	-	3	-	1	-	1	-
Whatcom	3	-	6	3.5	7	4.0	5	2.8	6	3.3
Whitman	1	-	0	-	1	-	0	-	0	-
Yakima	10	4.7	15	6.6	8	3.5	8	3.5	12	5.2
TOTAL	258	4.4	258	4.3	252	4.1	250	4.0	244	3.9

Note: rates not calculated for cases < 5; counties not shown did not report any TB cases over the past 5 years.

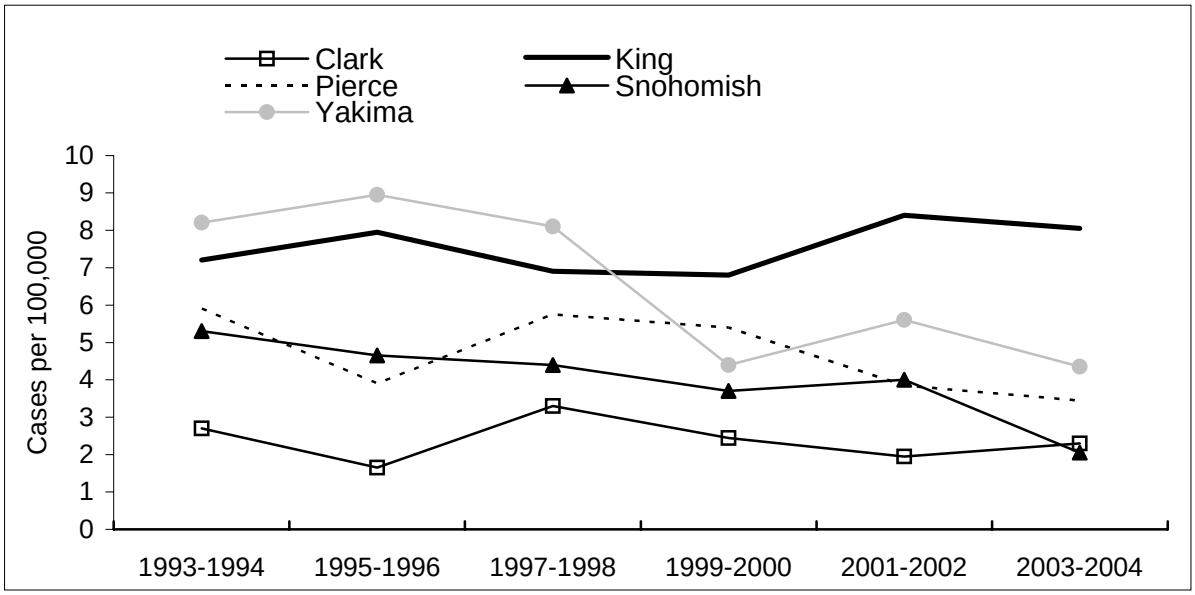
Figure 4
Number of counties by tuberculosis case number grouping in Washington, 2000-2004



Ten-Year County Trends

- Among counties with the highest case numbers over the past ten years (Clark, King, Pierce, Snohomish, and Yakima) ten-year trends indicate decreases in case rates among these counties except for Clark County, where case rates have been on the rise in more recent years (Figure 5).

Figure 5
Tuberculosis incidence rates for select counties in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Age and Gender Distribution

2004 Highlights

- In 2004, persons age 25-44 years had the highest proportion of cases (33%) followed by those age 45-64 years (28%) (Table 3).
- Persons age 65 years and older continue to have the highest incidence rate, 7.3 per 100,000 (Table 3). Reasons for higher rates among the elderly include increased likelihood of infection earlier in life (early 1900s when TB transmission was more common) and age-dependent changes in underlying health that increase the risk for TB (e.g., immunosuppression, diabetes).
- Among all age groups, the gender-specific incidence rate continues to be greater for males; however, none of these differences reached statistical significance except for persons age 45-64 years old (Figure 6). With increasing age, male/female differences increase, most likely due to behavioral factors linked to acquisition and reactivation of latent TB infection.
- In 2004, the difference between gender-specific incidence rates did not reach statistical significance as compared to 2003 (Figure 7).

Table 3
Tuberculosis cases by age group in Washington, 2004

Age	Rate	No.	(%)
0-4	0.9	4	(2)
5-14	0.2	2	(1)
15-24	4.4	39	(16)
25-44	4.5	80	(33)
45-64	4.3	68	(28)
65 and over	7.3	51	(21)

Figure 6
Gender and age-specific tuberculosis incidence rates (95% CI) in Washington, 2004

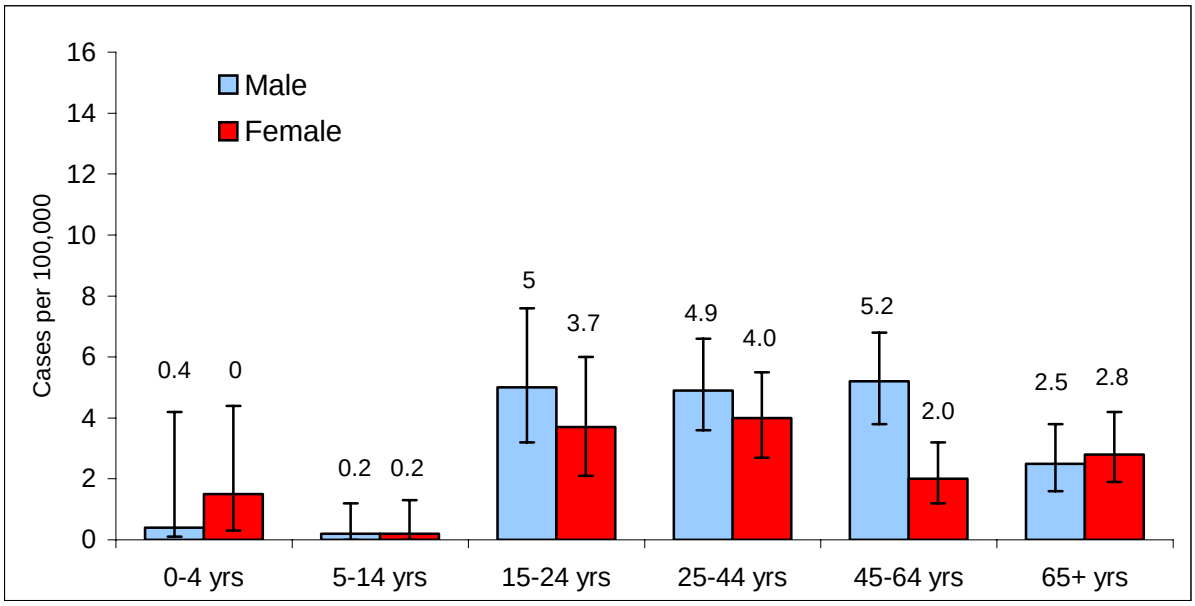
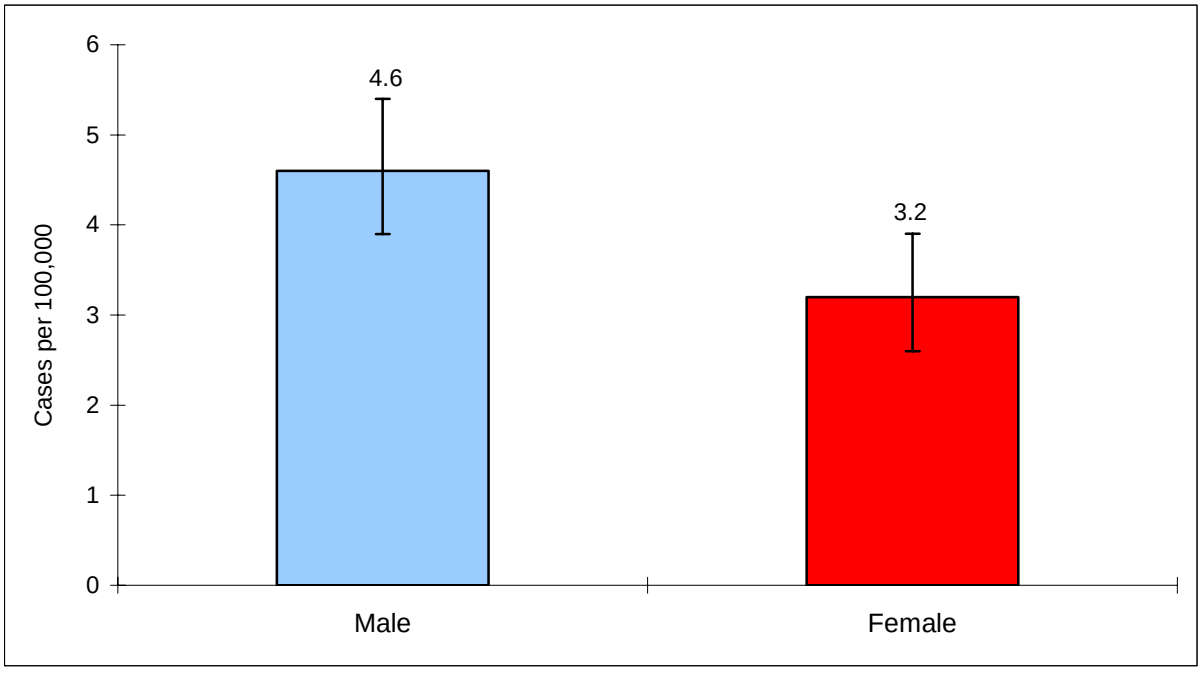


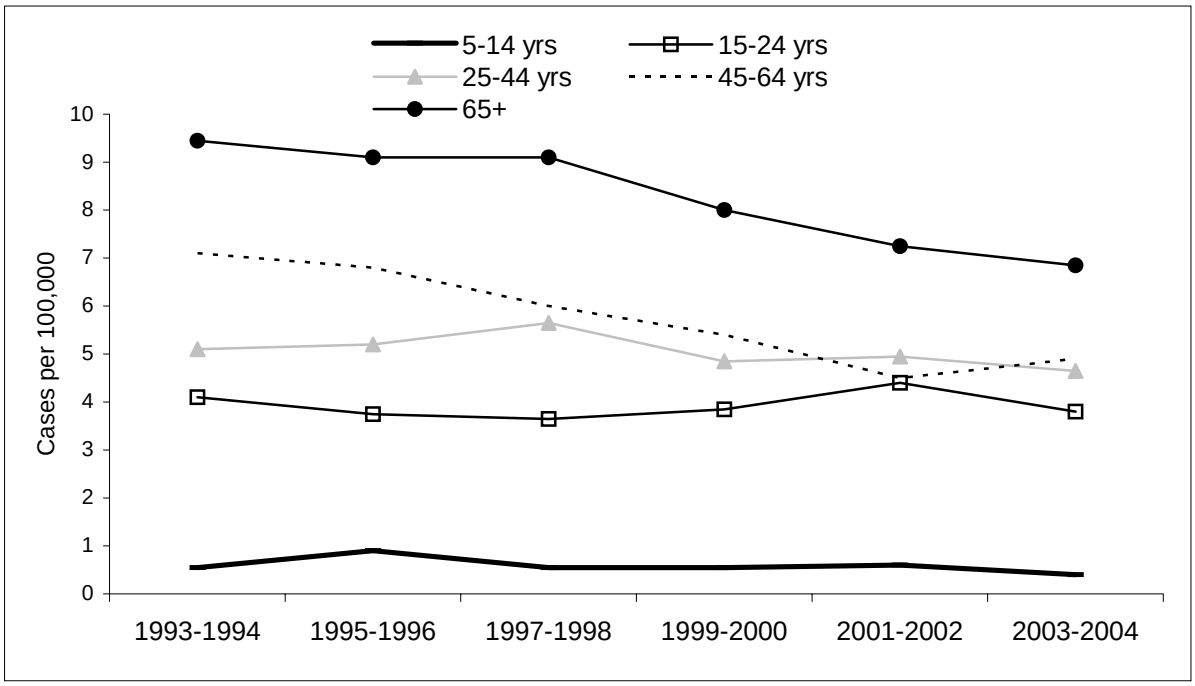
Figure 7
Gender-specific tuberculosis incidence rates (95% CI) in Washington, 2004



Ten-Year Age and Gender Trends

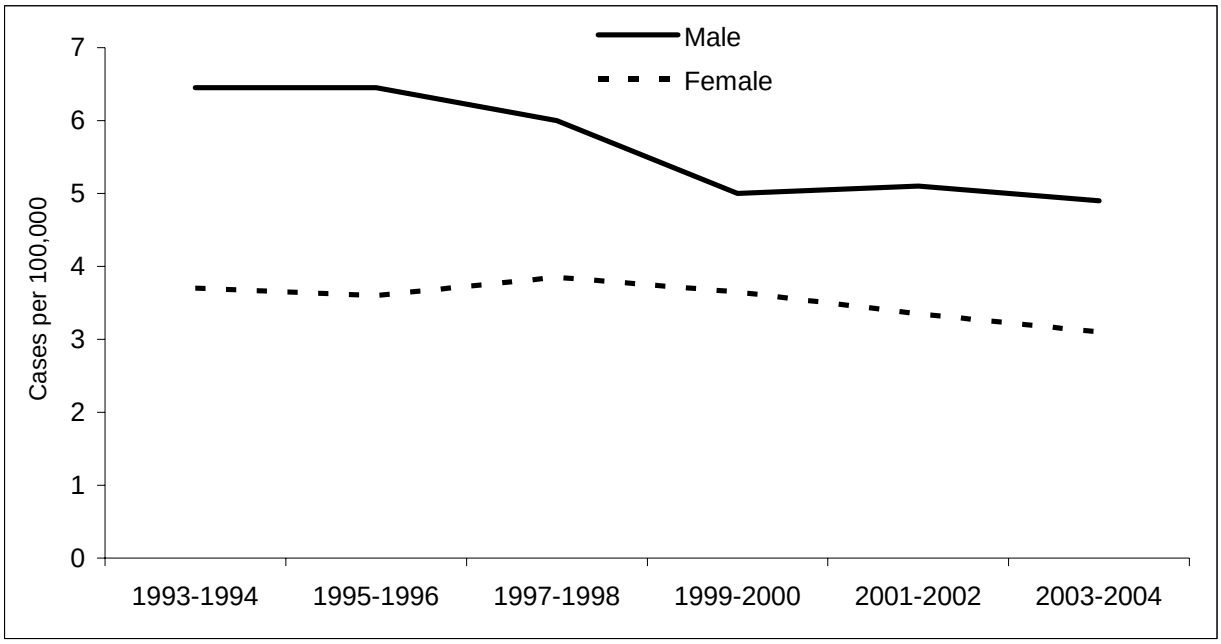
- A decreasing trend in TB rates was found across most of the age groups (Figure 8). However, because of low case numbers, none of these decreases have reached statistical significance.
- Persons age 5-14 years consistently had the lowest incidence rate (Figure 8).
- From 1995-2000, gender-specific incidence rates have steadily decreased in males (6.8 in 1995 to 4.8 in 2000) and the previously seen difference between genders (2:1 in 1995) continues to narrow (Figure 9).

Figure 8
Age-specific tuberculosis incidence rates among select age groups in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Figure 9
Gender-specific tuberculosis incidence rates in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Distribution of Race/Ethnicity

2004 Highlights

- Certain racial and ethnic groups continue to be overrepresented in the TB data in 2004. Asians had a case rate that was more than fifteen times higher than whites and almost four times higher than that of Hispanics. Blacks had a case rate fourteen times higher than that of whites and three times higher than that of Hispanics. The Washington case rate among whites remain below the national level (1.3 vs. 1.6, respectively) (Figure 10).
- The proportion of cases decreased slightly among Asians (44% to 39%) and Hispanics (16% to 14%). The proportion of cases increased slightly among blacks (14% to 20%), and whites remained stable (Table 4).
- Among blacks, an increasing proportion were foreign-born (79% in 2004 vs. 57% in 2003), primarily from Ethiopia. This may be due in part to the East African outbreak in King County (see Appendix 2 for a detailed description of the outbreak). Among whites, 41% were foreign-born and the majority were born in Mexico. The majority of Asian cases were born outside the U.S. (94%) (Table 4).

Figure 10
TB incidence rates by race/ethnicity in Washington, 2004

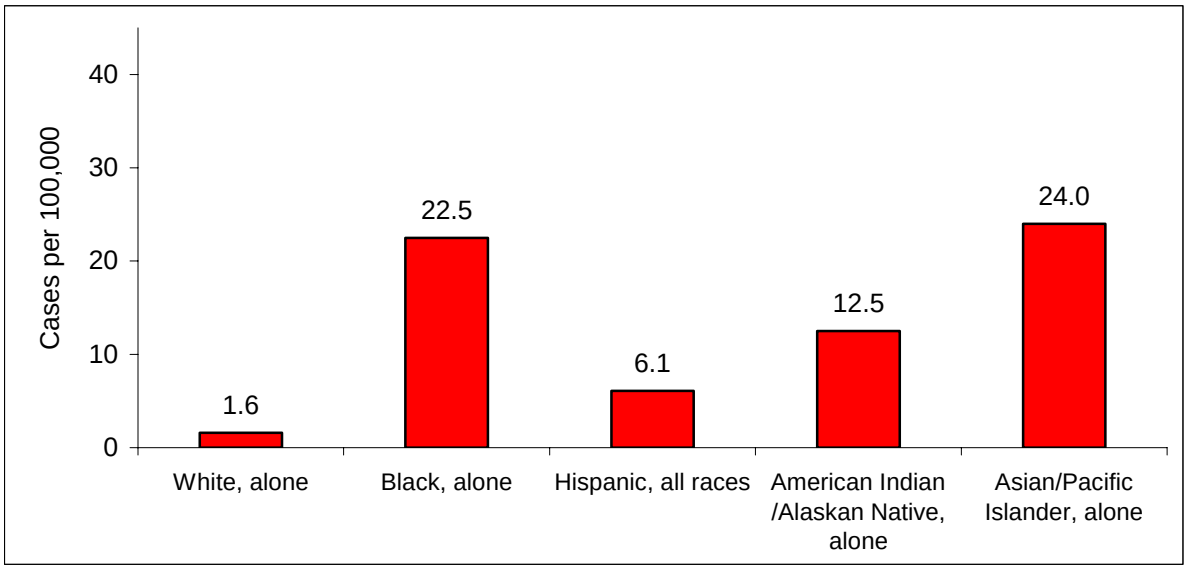


Table 4
Tuberculosis cases by race/ethnicity and country of origin in Washington, 2004

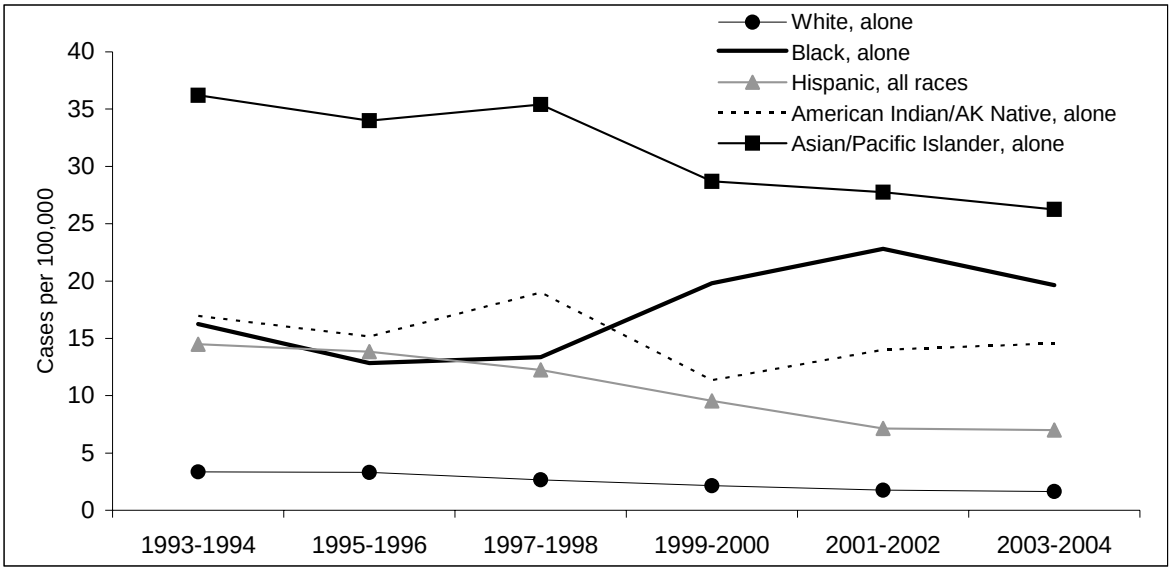
	U.S.-born		Foreign-born		TOTAL	
Race/Ethnicity	No.	(%)	No.	(%)	No.	(%)
White, alone	51	(59)	36	(41)	87	(36)
Black, alone	10	(21)	38	(79)	48	(20)
Hispanic, all races	8	(25)	24	(75)	32	(14)
American Indian/AK Native, alone	13	(100)	-	-	13	(5)
Asian/Pacific Islander, alone	6	(6)	89	(94)	95	(39)
Multi-Race	1	(100)	-	-	1	(<1)

Note: The multi-race option is a new race category for 2004.

Ten-Year Racial and Ethnic Trends

- Minority populations consistently have higher rates of TB than the state rate.
- Between 1997 and 2002 incidence rates among blacks increased (12.1 cases per 100,000 to 29.9 cases per 100,000) (Figure 11). The incidence rate among American Indians / Alaskan Natives has been on the rise since 2000 and case rates among Asian Pacific Islanders continue to decrease (Figure 11).

Figure 11
Tuberculosis incidence rates by race/ethnicity in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Country of Birth Distribution

2004 Highlights

- Sixty-seven percent (163 cases) of all tuberculosis cases in 2004 were among persons born outside the U.S. Foreign-born persons accounted for 64% (92/143) of male TB cases and 70% (71/101) of female TB cases. This corresponds to an estimated rate of 40-50 per 100,000, based upon a rough estimate of the resident foreign-born population in Washington State (350-400,000; 1996 INS estimated legal permanent residents at approximately 315,000). The rate among U.S.-born in Washington State is approximately 1.3 per 100,000.
- The majority of cases came from Asia or Southeast Asia (51%), followed by Africa, Central and South America, and Eastern Europe.
- The countries of origin for most cases were Vietnam (n=30), the Philippines (n=23), Mexico (n=18), South Korea (n=15), and Ethiopia (n=13) (Data not shown).
- Foreign-born cases of TB were younger than U.S.-born cases because foreign-born populations tend to be younger than the overall state population and primarily originate from countries with endemic TB. Sixty percent of all foreign-born TB cases were between 15 and 45 years of age while 26% of U.S.-born were within this same age group. Seventy percent of all U.S.-born cases were 45 years of age and older.
- Thirty-six percent (55/152) of foreign-born TB cases (those who did not have missing data on the date they entered the U.S.) had been in the U.S. for less than five years while 64% (97/152) had been in the U.S. five or more years (Table 5).

Figure 12
Tuberculosis cases by gender and country of origin in Washington, 2004

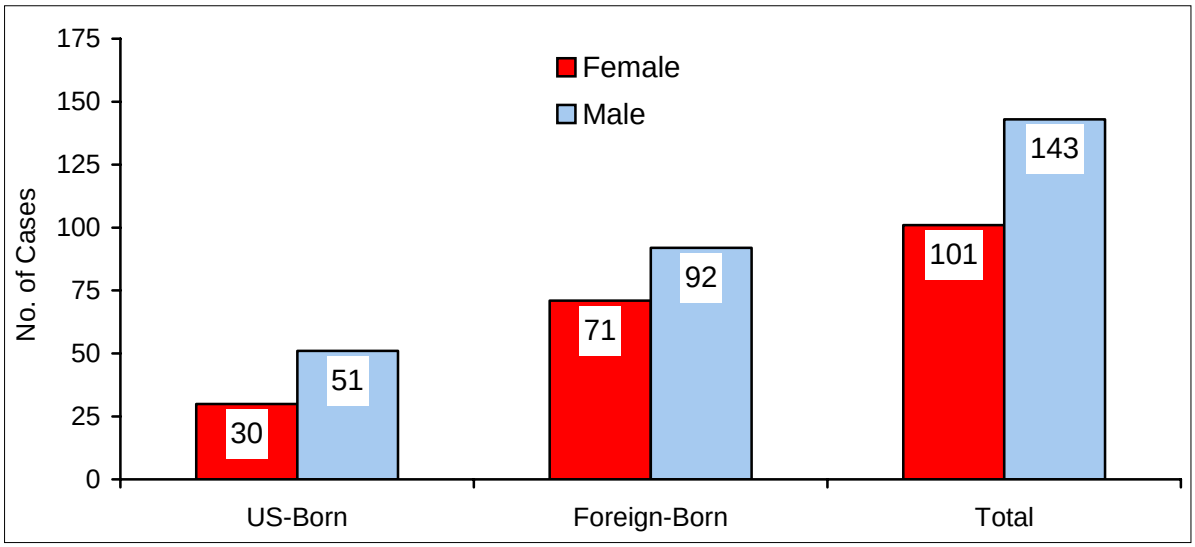


Figure 13
The number of foreign-born TB cases by world region in Washington, 2004

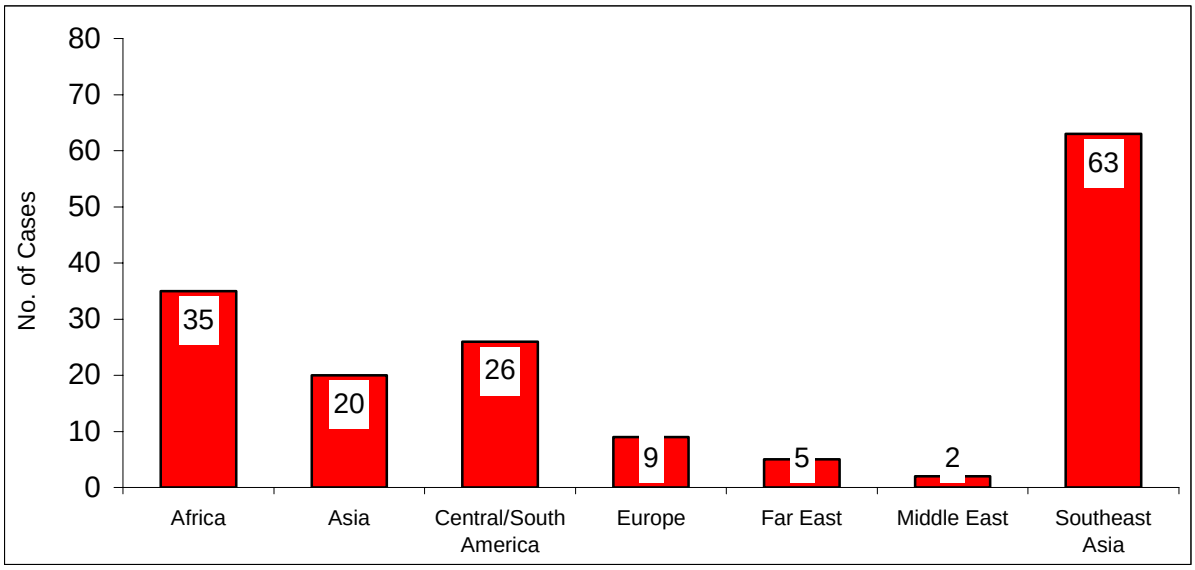


Table 5
Foreign-Born tuberculosis cases by age and length of time in the U.S., Washington, 2004

	Age					TOTAL	
Length of Time	0-15	15-24	25-44	45-64	65 and over	No.	(%)
Less than 1 year	2	2	8	1	1	14	(9)
1-4 years	1	11	24	4	1	41	(27)
5-9 years	0	6	13	4	5	28	(18)
10-19 years	0	7	12	14	10	43	(28)
20 years and over	-	2	7	4	13	26	(17)

Note: 11 missing responses

Ten-Year Foreign-Born Trends

- Southeast Asia comprised 43% of all foreign-born arrivals in the last ten years (Data not shown).

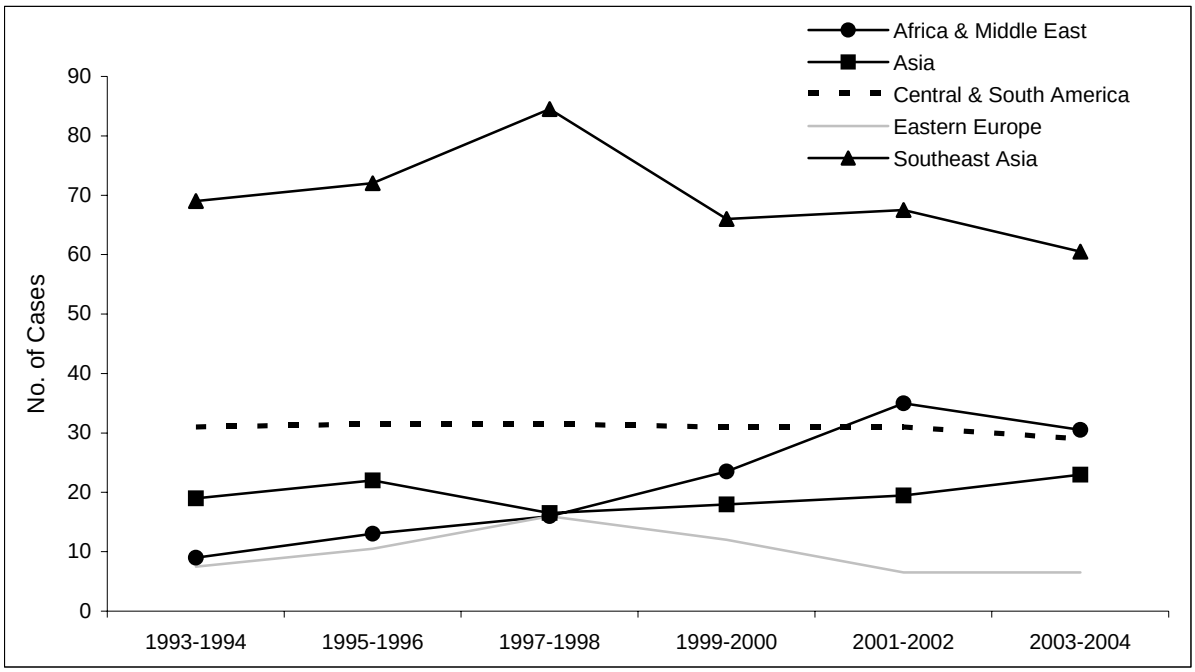
- The number of cases among Africans appears to have decreased over the last few years (Figure 14). However, in 2004 the number of foreign-born cases among African immigrants increased and may be a result of the East African outbreak in King County (35 cases in 2004 vs. 24 cases in 2003) (Figure 14).

- In the past ten years, a greater proportion of cases were among foreign-born persons. More females than males comprised foreign-born cases in the last ten years.

- A shift in the number of cases between persons born inside the United States and those born outside has occurred since 1992 but this gap may be narrowing (Figure 16).

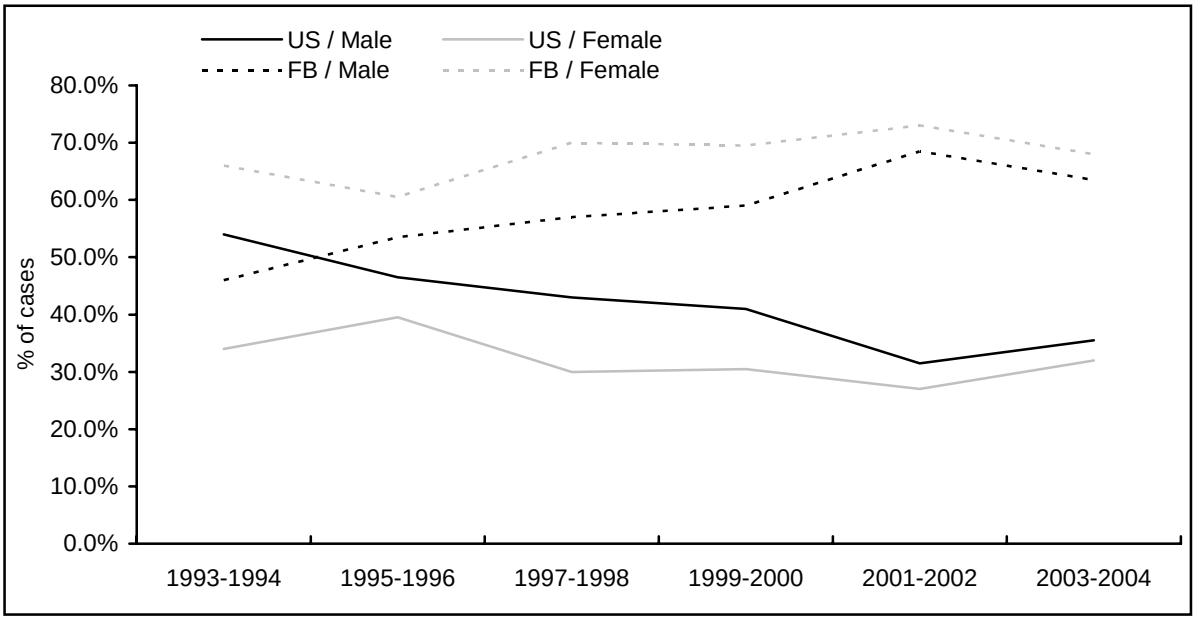
- From 1994-2001, the number of TB cases among foreign-born persons increased 32%. However, from 2001-2004 the number of cases among foreign-born persons decreased 13% (187 cases vs. 163 cases, respectively). This decrease was mostly likely due to the TB outbreak among homeless persons in King County, which began in 2002 and is primarily comprised of U.S.-born cases (Figure 16).

Figure 14
Tuberculosis cases by selected regions among foreign-born populations in Washington, 1993-2004



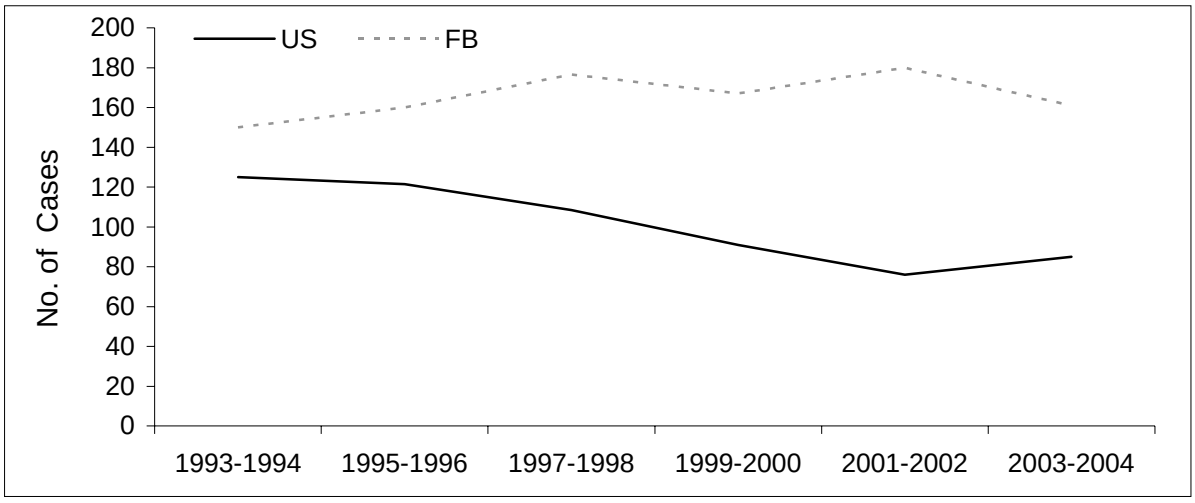
Note: 2-Year rolling averages were used to compare trends over time.

Figure 15
Gender distribution of tuberculosis cases by country of origin in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Figure 16
Tuberculosis cases by country of origin, Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Risk Markers

- Nationally identified high-risk groups continue to present as part of TB morbidity in 2004.

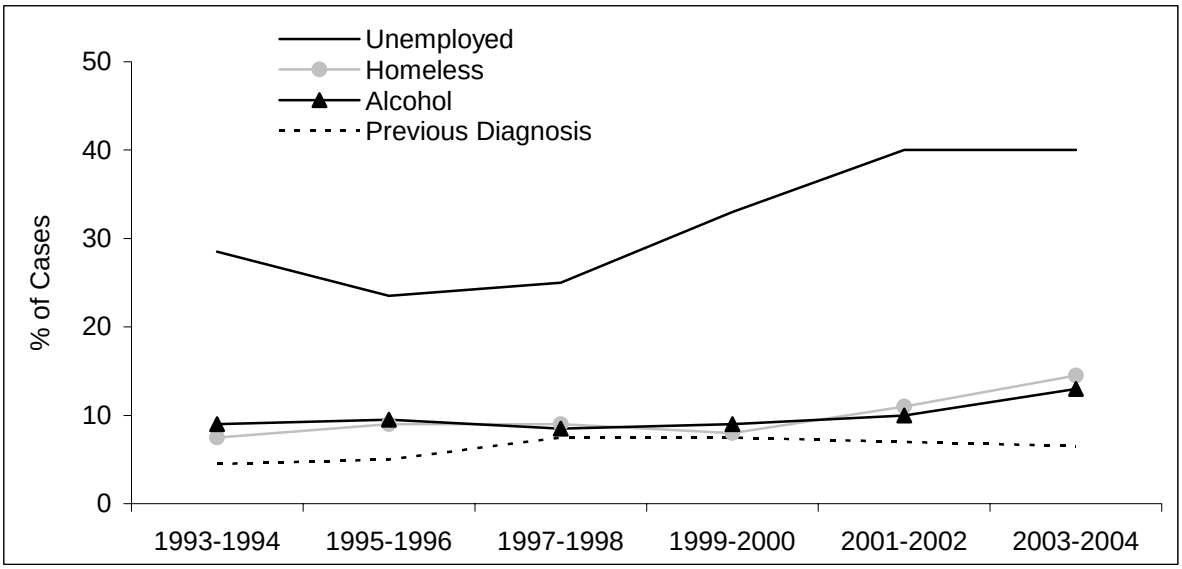
- Since 2001, the proportion of cases attributed to homelessness and excess alcohol use has been on the rise (Figure 17). This rise may be due in part to the TB outbreak among homeless persons in King County, which began in 2002.

Table 6
Risk factors for tuberculosis, Washington, 2004

Risk (# of months)	No.	(%)
Foreign-Born	163	(67)
Unemployed[a] (24)	104	(43)
Homeless (12)	33	(14)
Excess Alcohol	29	(12)
Other Drug Use[b] (12)	25	(10)
Previous Diagnosis of TB	19	(8)
Health Care Worker (24)	11	(5)
HIV/AIDS Positive	9	(4)
Resident of Correctional Facility[c]	9	(4)
Injecting Drug Use[b] (12)	9	(4)
Resident of Long Term Facility[c]	7	(3)
Migrant Worker (24)	2	(1)

[a] may include housewives and students; [b] may be underreported; [c] at time of diagnosis.
Note: more than one risk factor may be selected per case.

Figure 17
Selected tuberculosis risk factors over a ten-year period in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Close Contacts

- Among the 244 cases reported in 2004, 186 cases of pulmonary (adult and pediatric) TB and 3 pediatric cases of extra-pulmonary TB were eligible for contact investigation. There were 887 contacts identified for 63% of all eligible cases (120/189); an improvement from 2003 where contacts were identified for 55% of the eligible cases. An average of 7.39 contacts were identified per case with a range of 1-86 contacts identified per case.
- Of the infectious TB cases (smear positive or a cavitary chest x-ray) in 2004 (n=101), 709 contacts were identified. The CDC recommends that at least 90% of close contacts to infectious TB cases receive examinations. Washington State achieved this objective in 2004 with 98% (698/709) of the contacts receiving initial examination.
- Treatment of latent TB infection was started for 74% (137/184) of all infected contacts to infectious TB cases, an improvement from 2003 (68%). Among infected contacts less than 15 years of age (n=22), 77% initiated treatment of latent TB infection, a decrease from 2003 (92%). Among infected contacts ages 15 and older (n=162), 74% initiated treatment of latent TB infection, an improvement from 2003 (66%).
- Among contacts that started therapy in 2003, 53% (166/315) completed treatment. Seventy-seven percent (127/166) of contacts completed at least six months of therapy and 23% (39/166) had completed less than six months of therapy. Of those who did not complete therapy, ten had chosen to stop treatment on their own, nine were lost to follow-up, three died, and 102 (32%) were still on therapy at time of report.

Clinical Distribution

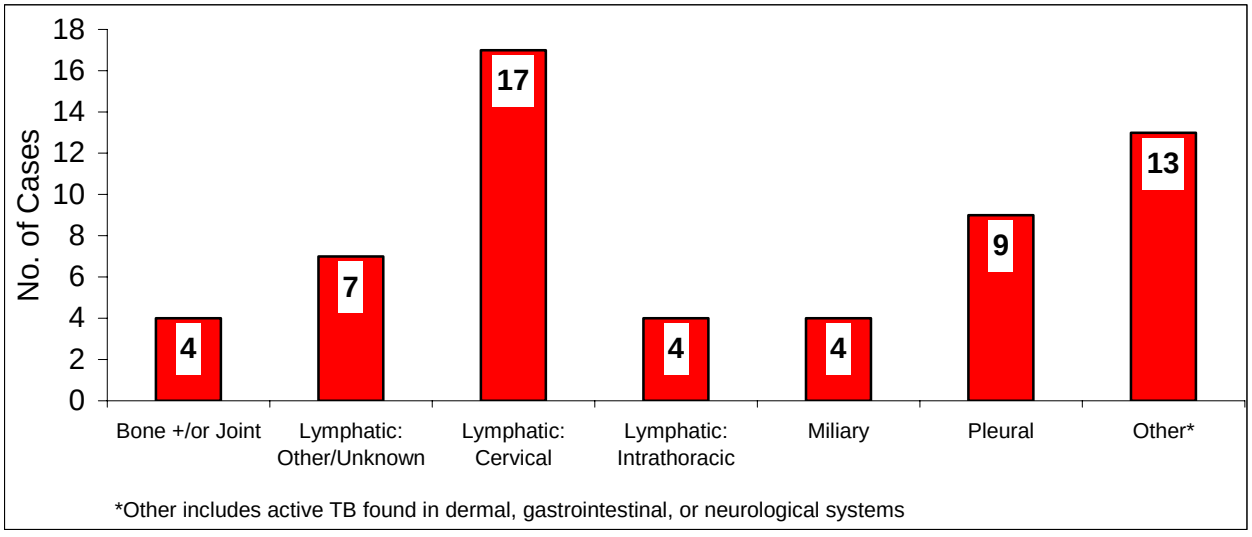
Site of Disease

- In 2004, the majority of cases continued to be pulmonary.
- The proportion of pulmonary cases remained stable with an average of 64% from 2000-2004 (Table 7). In 2004, a larger proportion of foreign-born cases were extra-pulmonary as compared with U.S.-born cases (25% vs. 14%, respectively) (Data not shown).
- The greatest number of extra-pulmonary TB cases involved the cervical lymphatic system (n=17) (Figure 18).

Table 7
Tuberculosis cases by site of disease in Washington, 2000-2004

	2000 (n=258)		2001 (n=261)		2002 (n=252)		2003 (n=250)		2004 (n=244)	
Site	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Pulmonary	176	(68)	150	(57)	155	(62)	163	(65)	169	(69)
Extra-Pulmonary	66	(24)	84	(32)	76	(30)	64	(26)	51	(21)
Both Pulmonary & Extra	16	(6)	27	(10)	21	(8)	23	(9)	24	(10)

Figure 18
Distribution of extra-pulmonary tuberculosis site of disease in Washington, 2004



Bacteriology

- The proportion of TB cases from which *Mycobacterium tuberculosis* was isolated have remained stable from 2000-2004.
- The CDC recommends that diagnostic measures are thorough enough such that ≥85% of all tuberculosis cases are confirmed through isolation of the organism. This increases the specificity of the diagnosis and permits the performance of susceptibility testing, both of which benefit patient care and surveillance information. Washington State achieved did not achieve this objective in 2004 with only 83% of cases confirmed through positive cultures (Table 8).
- Of the 189 pulmonary TB cases, 49% (93/189) had a positive sputum smear and 25% (48/189) had a cavitary x-ray (Data not shown). These are crude markers of the proportion of cases that were infectious in 2004.

Table 8
Proportion of tuberculosis cases confirmed by culture in Washington, 2000-2004

	Culture + No.	Total Cases No.	Percent of total (%)
2000	228	258	(88)
2001	228	261	(87)
2002	224	252	(89)
2003	216	250	(86)
2004	203	244	(83)

Therapy

CDC Therapy Recommendations

- Of the 242 cases who were alive at the time of their TB diagnosis, 86% (n=209) were prescribed four anti-mycobacterial drugs—isoniazid, rifampin, pyrazinamide, and either ethambutol or streptomycin—as initial therapy for active TB. The American Thoracic Society and CDC recommend the use of this regimen as initial therapy in communities where INH resistance is found in more than 4% of isolates (see resistance data below).

Directly Observed Therapy[2,3]

[2] Because failure to adhere to treatment increases transmission and increase risk of drug resistance, DOT is becoming a clinical and public health standard of practice for TB control.
[3] With the current TB reporting system, DOT information is not available until the patient completes therapy, therefore a year delay in the report of information will be seen from this report on.

- The proportion of cases known to have some DOT administered increased from 2001 to 2003 (73% vs. 89%, respectively). In 2003, DOT usage increased 10% from the previous year (Table 9).

Table 9
Directly Observed Therapy (DOT) among all TB cases in Washington, 1999- 2003

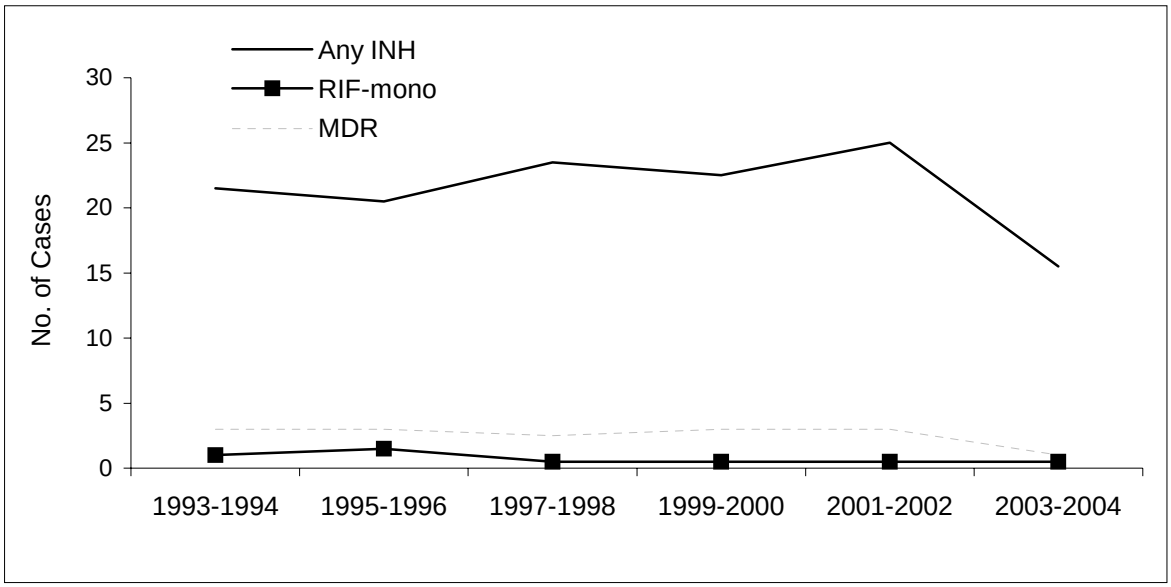
	Total Cases	Cases with Initial Drug Regimen[a]	Cases with Information on DOT		DOT only or Both DOT & Self Administered[b]	
	No.	No.	No.	(%)	No.	(%)
1999	258	248	240	(97)	189	(79)
2000	258	252	252	(100)	209	(83)
2001	261	257	238	(93)	174	(73)
2002	252	250	226	(90)	178	(79)
2003	250	249	237	(95)	211	(89)

[a] Includes patients alive at diagnosis with initial drug regimen of one or more drugs
[b] Calculated from cases with known information on DOT

Drug Susceptibility Testing and Resistance

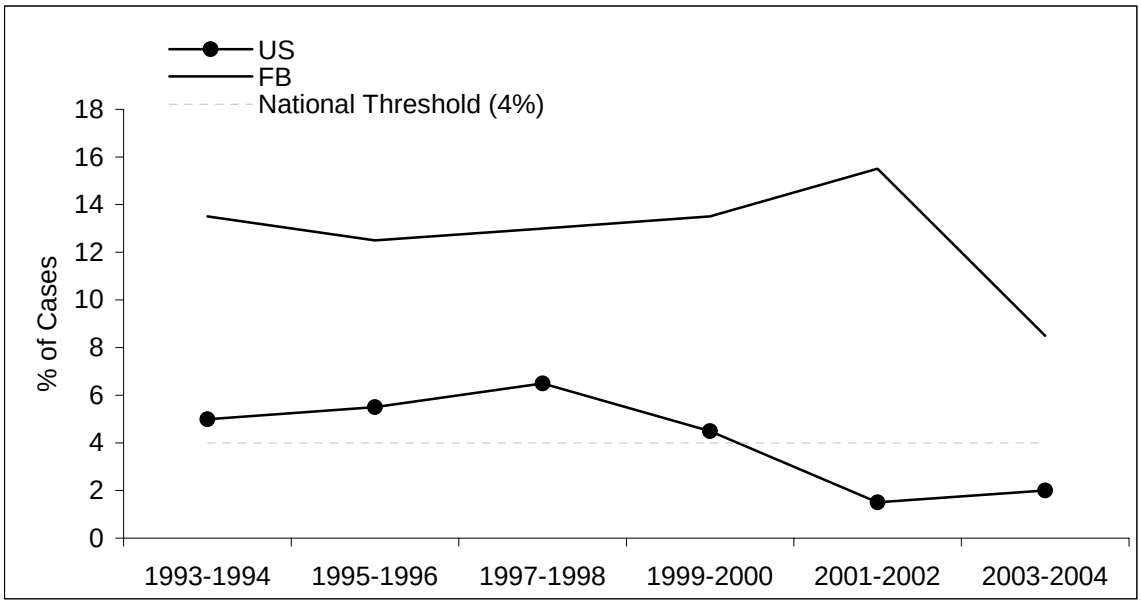
- Of the 203 culture-positive TB cases in 2004, 203 (100%) had drug susceptibility testing done.
- Eighty-four percent (170/203) had no resistance to anti-tuberculosis medicines.
- Thirty-three (16%) had resistance to at least one anti-mycobacterial drug. Eighteen (9%) were resistant to INH. Drug resistance to INH increased slightly in 2004 (18 cases in 2004 vs. 13 cases in 2003). RIF resistance remains low; there was only 1 rifampin-only resistant case in 2004. The number of MDR cases increased since last year, 2 cases were reported with MDR TB in 2004 (Figure 19).
- From 1998-2002, an increasing proportion of foreign-born persons had resistance to INH as compared with U.S.-born. U.S.-born resistance has remained below the national threshold (4%) since 2000 (Figure 20).
- Foreign-born cases comprised 79% of all drug resistant TB cases in 2004, indicating a 2% increase from the previous year. More men than women were drug resistant in 2004. Eighty-one percent of all drug-resistant TB cases over the last five years were among foreign-born persons. (Table 10).
- Drug resistance has been observed in all ages, genders, racial groups, and global regions of origin (including the United States). The majority of the drug resistant cases continue to be among foreign-born persons and Asian / Pacific Islanders (Table 10).

Figure 19
Drug resistance patterns for tuberculosis cases in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Figure 20
INH drug resistance among foreign & U.S.-born cases in Washington, 1993-2004



Note: 2-Year rolling averages were used to compare trends over time.

Table 10
Characteristics of drug-resistant tuberculosis cases by year in Washington, 2000-2004

	2000 (n=40)		2001 (n=44)		2002 (n=40)		2003 (n=26)		2004 (n=33)	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Age (years)										
0 - 4	0	(-)	1	(2)	1	(3)	0	(-)	1	(3)
5 - 14	3	(8)	2	(5)	0	(-)	3	(12)	0	(-)
15 - 24	3	(8)	5	(11)	6	(15)	2	(8)	5	(15)
25 - 44	17	(43)	21	(48)	14	(35)	10	(38)	12	(36)
45 - 64	10	(25)	9	(20)	6	(15)	8	(31)	10	(30)
65+	7	(18)	6	(14)	13	(33)	3	(12)	5	(15)
Sex										
Male	19	(48)	31	(70)	20	(50)	13	(50)	19	(58)
Female	21	(53)	13	(30)	20	(50)	13	(50)	14	(42)
Race/Ethnicity										
White, alone	3	(8)	7	(16)	5	(13)	4	(15)	10	(30)
Black, alone	4	(10)	8	(18)	4	(10)	2	(8)	6	(18)
Hispanic, all races	4	(10)	3	(7)	8	(20)	4	(15)	4	(12)
American Indian/Alaskan Native	2	(5)	3	(7)	0	(-)	2	(8)	0	(-)
Asian/Pacific Islander	27	(68)	23	(52)	22	(55)	18	(69)	17	(52)
Country of Birth										
U.S.-born	8	(20)	9	(20)	4	(10)	6	(23)	7	(21)
Foreign-born	32	(80)	35	(80)	36	(90)	20	(77)	26	(79)

Tuberculosis and HIV/AIDS

- The number of TB cases among persons with HIV/AIDS decreased from 12 cases in 2003 to 9 in 2004.
- Persons co-infected with HIV and TB have traditionally resembled some of the anticipated characteristics of the HIV epidemic, late-20's to early-40's, males and females infected, whites, blacks and Hispanics. The median age for TB-AIDS cases in 2004 was 44 years.

TB-Related Deaths

- In 2004, two cases were dead upon diagnosis and an additional seven cases died after diagnosis. All deaths that were tuberculosis-related and occurred during treatment in 2004 had another primary cause of death. During 2000-2004, only 1-2% of all cases had TB as the primary cause of death (Table 11). The crude death rate for TB in 2004 was 1.1 per one million people.

Table 11
Deaths among all tuberculosis cases in Washington, 2000-2004

	2000 (n=258)		2001 (n=261)		2002 (n=252)		2003 (n=250)		2004 (n=244)	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Death due to TB	2	(1)	6	(2)	4	(2)	5	(2)	3	(1)
Non-TB Death	13	(5)	4	(2)	3	(1)	6	(2)	4	(2)
Living TB Cases	242	(94)	251	(96)	245	(97)	239	(97)	235	(96)

Washington State Cohort Review

Annual Analysis of 2003 Cases and their Contacts

Cohort review is a systematic review of patients with tuberculosis (TB) disease and their contacts. A "cohort" of patients from a specific period of time is reviewed and analyses are based upon individual patient outcomes. Cohort review is a tool used to increase staff knowledge, hold staff accountable to the management of their TB cases, and identify program strengths and weaknesses. The review allows staff to ask expert clinicians and managers about patient care. Patients are less likely to "fall through the cracks" and receive inadequate care. The Washington (WA) State TB Program implemented cohort review in May of 2003. Washington State is considered a medium incidence state (3.9 cases per 100,000 population in 2004).

Cohort review sessions are conducted on cases counted in a 3 month period beginning 9 months earlier. In addition to case reviews, analyses of cases and their contacts are provided. An annual analysis of the outcome and timeliness measures was conducted for 2003 cases and their contacts (post 1 year of implementing cohort review). The purpose of the analysis is to measure the impact of cohort review on the management of TB cases in WA State.

Since implementation in WA State, cohort review has increased knowledge of tuberculosis among staff and has held staff accountable for the management of their cases. A review of the 2003 cases have shown that the closer scrutiny of cases and contacts and an increased understanding of TB morbidity during cohort review sessions have improved patient outcomes and the treatment of cases and contacts in Washington State.

Case Outcome Measures

Selected outcome measures are reviewed every quarter at a cohort review session. The percentage of cases on Directly Observed Therapy (DOT), comprises those cases closed out (i.e.; completed treatment, moved, lost, or died) and cases that were either all on DOT or were both DOT and self-administered TB medication. Figure 21 shows a steady improvement from the beginning of 2003 to the end of 2003 among King County cases (88% vs. 100%, respectively) and cases outside of King County (65% vs. 90%, respectively). Closer scrutiny of DOT usage each quarter may be attributable to the increase throughout the state.

Figure 21
Percentage of Directly Observed Therapy (DOT) usage, Washington, 2003

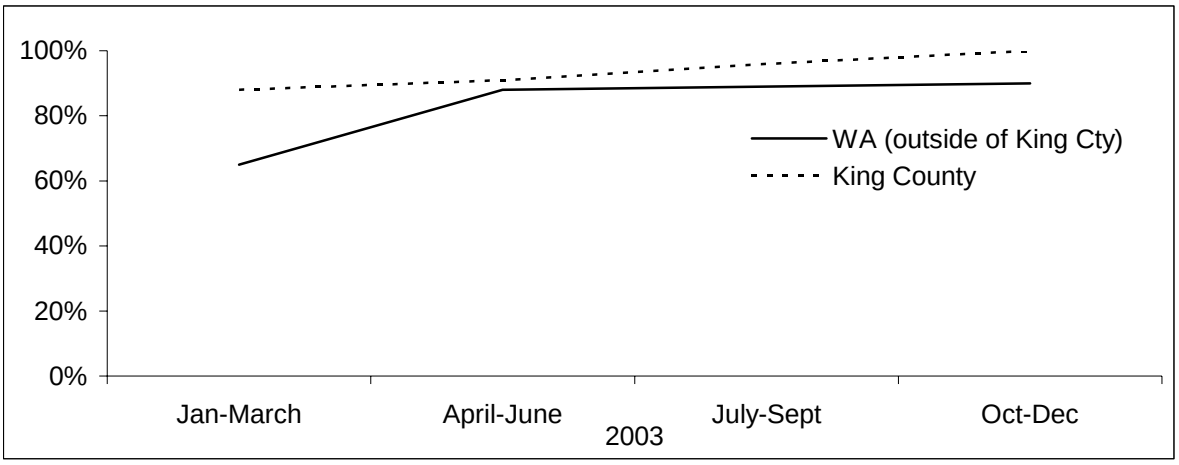


Figure 22 shows a decrease in the proportion of cases completing treatment in both King County (94% vs. 76%) and outside of King County (100% vs. 87%) in 2003. Contributing factors to the decrease in the completion of therapy include cases that died during treatment or were lost. In 2003, 8 (5%) King County cases and 5 (5%) cases outside of King County died without completing treatment while 3 (2%) King County cases and 1 (1%) case outside of King County case were lost (Figure 23).

Figure 22
Percentage of completion of therapy, Washington, 2003

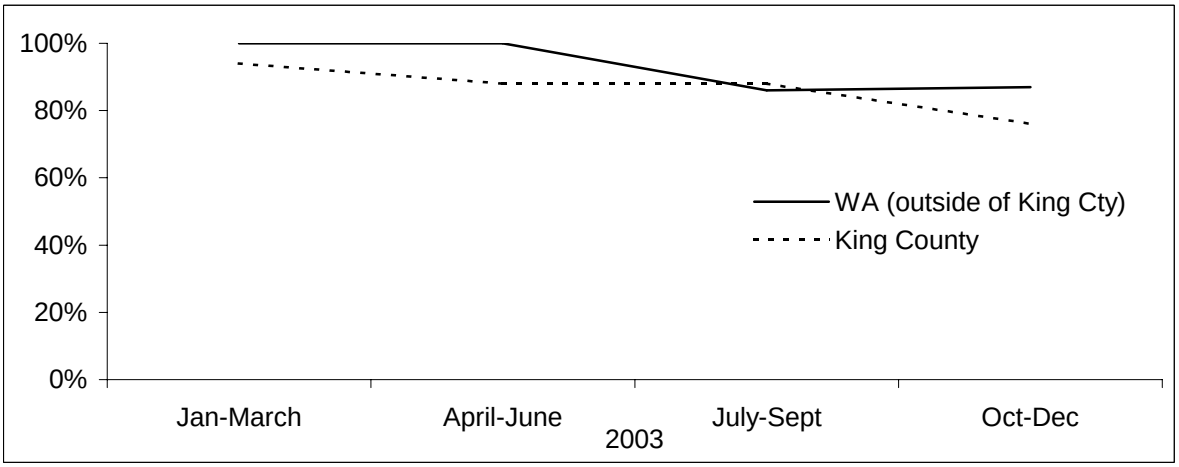
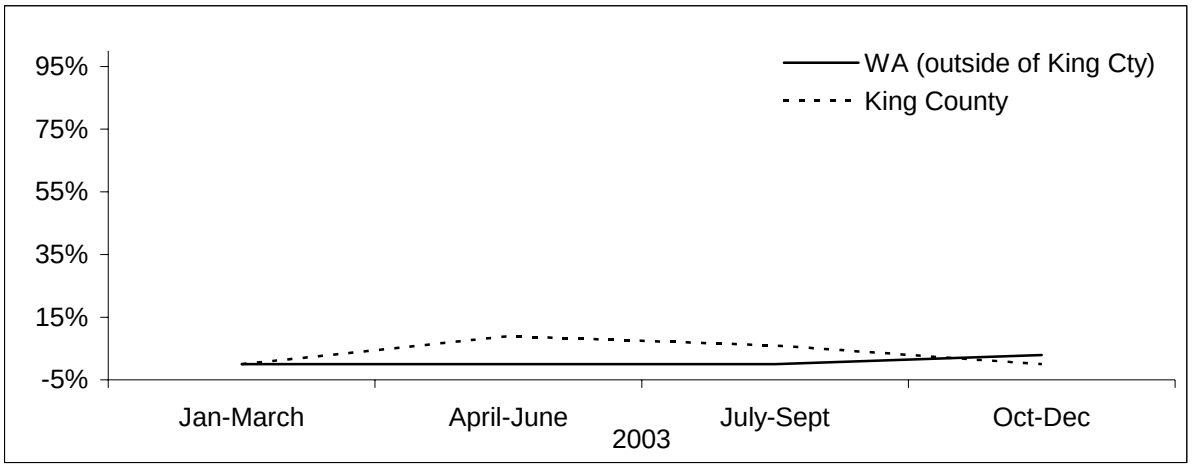


Figure 23
Percentage of cases lost to follow-up, Washington, 2003



In 2003, cases not offered an HIV test at the time of their screening for TB and those not completing treatment within 12 months, showed no clear trends throughout the year for both King and outside of King County cases (Figure 24 and figure 25).

Figure 24
Percentage of cases not offered an HIV test at the time of TB screening, Washington, 2003

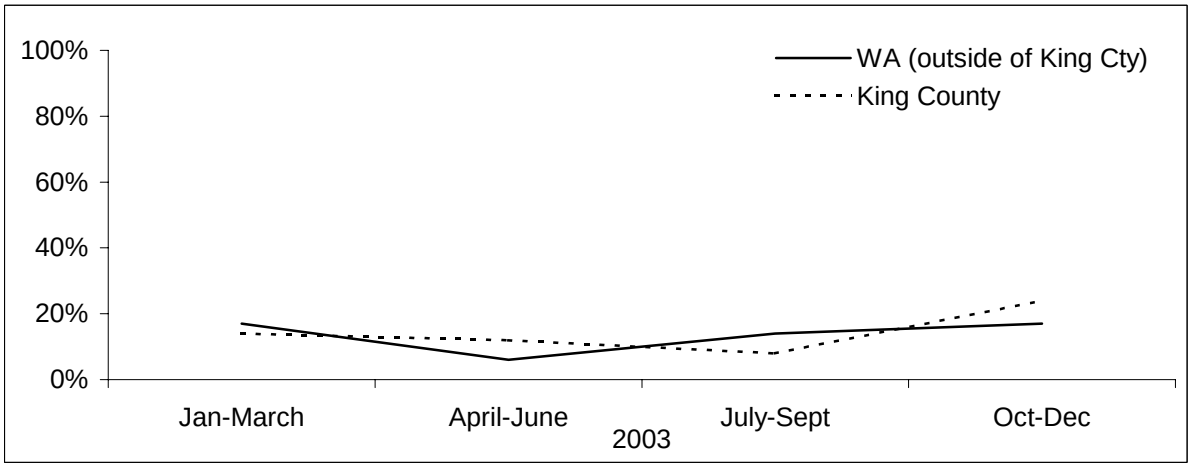
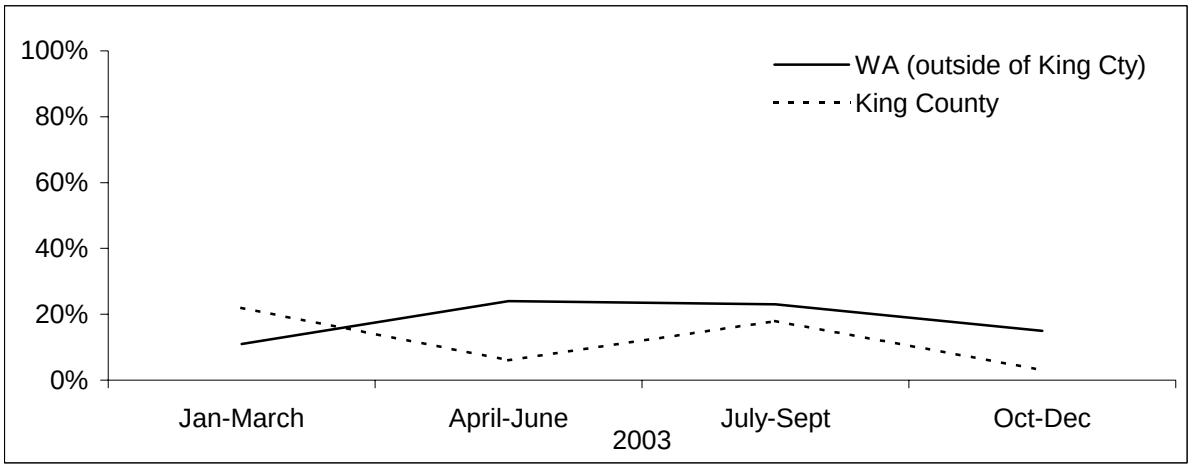


Figure 25
Percentage of cases not completing therapy within 12 months, Washington, 2003



Case Timeliness Measures

Timeliness measures refer to outcome measures incorporated by DOH in order to review the timelines of reporting specific case information between labs, health care providers, local health jurisdictions, and DOH. For each cohort review session, timeliness measures are evaluated by reviewing the median (middle) number of days between 2 dates for review. Median was used as the analysis tool for reviewing measures of dispersion because outliers, or dates that are abnormal, are ignored. This gives a better indication of the true number of days between the 2 dates.

Figure 26 shows the median number of days between when sputum was collected and when it was received at the lab. Both King County and Washington State reported less than 2 days for 2003.

Figure 26
Median number of days between sputum collection and when it was received at a lab, Washington, 2003

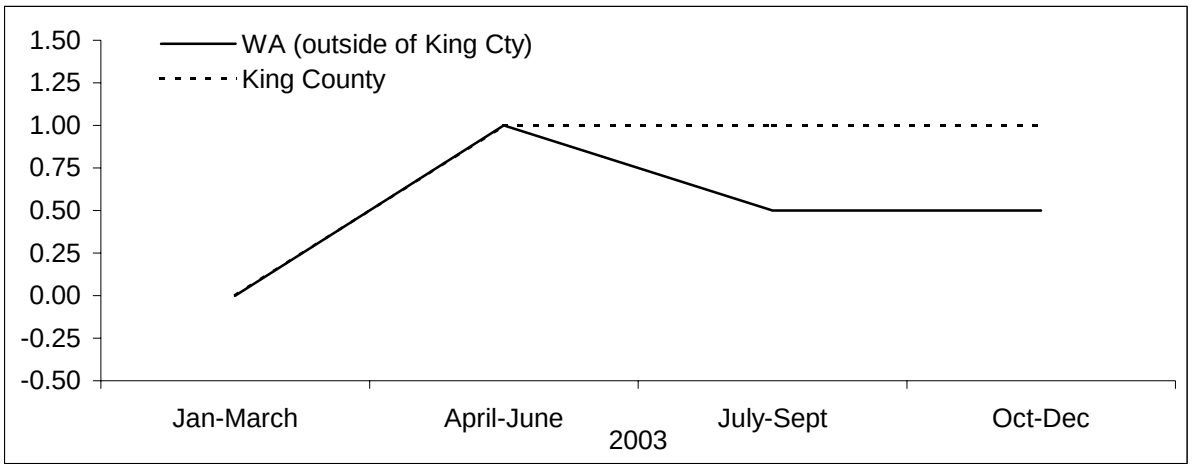


Figure 27 shows the median number of days between the date the case reported at smear + result and when TB medication was started. For some quarters, a negative number of days was reported which indicates that TB medication was started prior to receiving the smear + result.

Figure 27
Median number of days between the smear + date and when TB medication was started, Washington, 2003

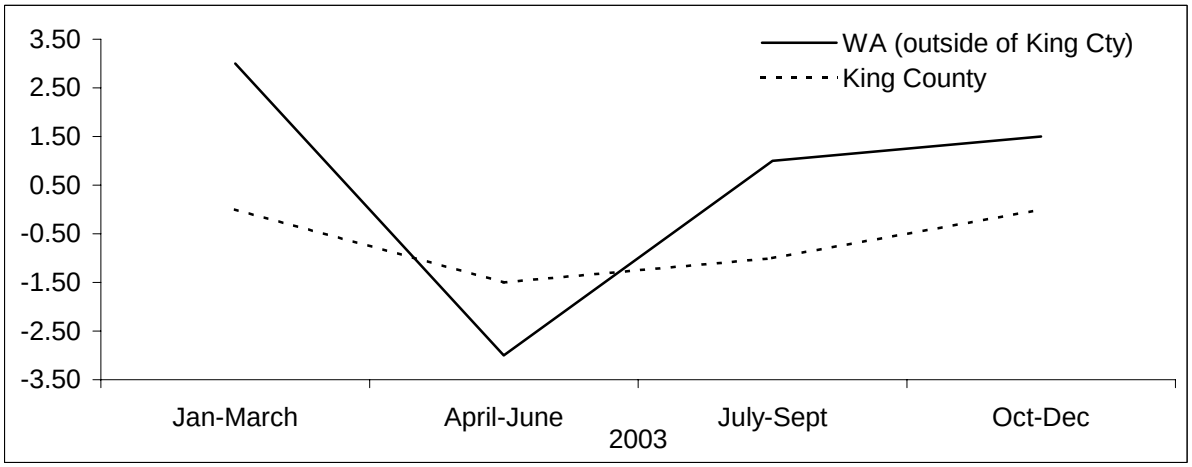


Figure 28 shows the number of days between the smear + result and when the LHJ reported the case to DOH. King County reported about 20-15 days between the smear + result to when they reported the case to DOH while all other counties reported less than 5 days.

Figure 28
Median number of days between the smear + date and when the LHJ reported the case to DOH, Washington, 2003

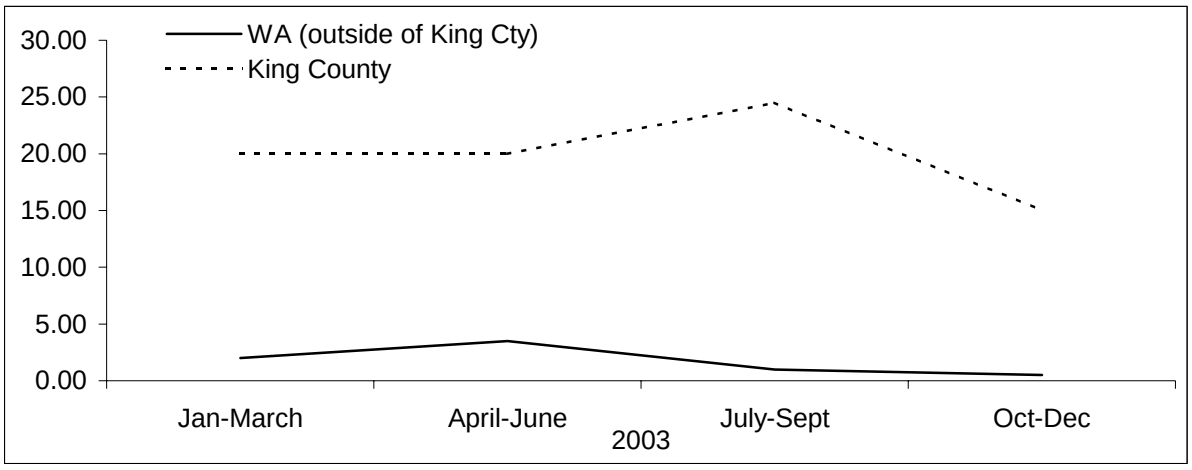


Figure 29 shows the number of days between the smear + result and when the health care provider reported the case to either the LHJ or DOH. For most of 2003, King County and Washington State health care providers reported the case to the LHJ prior to receiving the smear + result.

Figure 29
Median number of days between the smear + date and when the health care provider reported the case to the LHJ, Washington, 2003

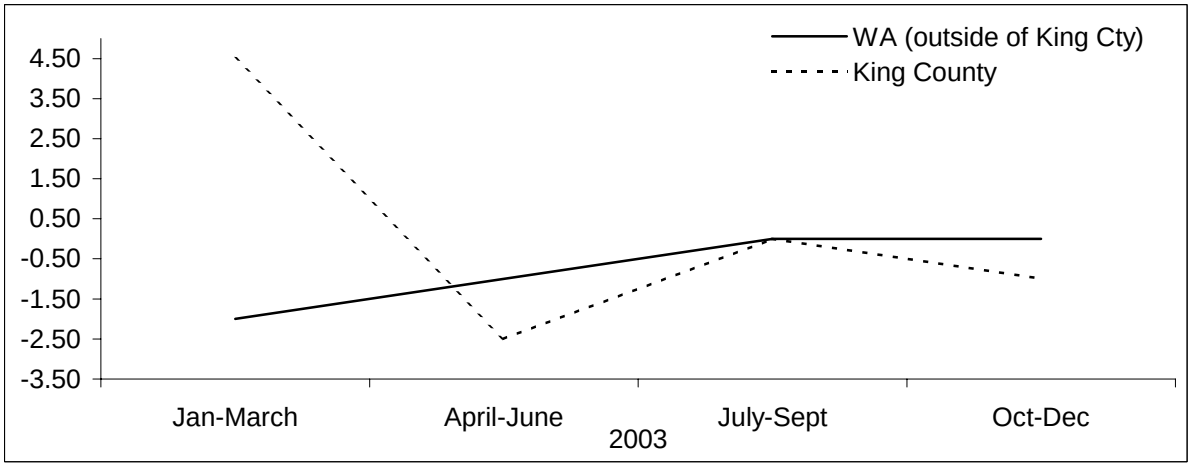


Figure 30 shows the number of days between the smear + result and when a lab reported the information to the LHJ. For both King County and the rest of Washington State, the labs reported the information to the LHJ on the same day as the smear + result.

Figure 30
Median number of days between the smear + date and when a lab reported that information

to the LHJ, Washington, 2003

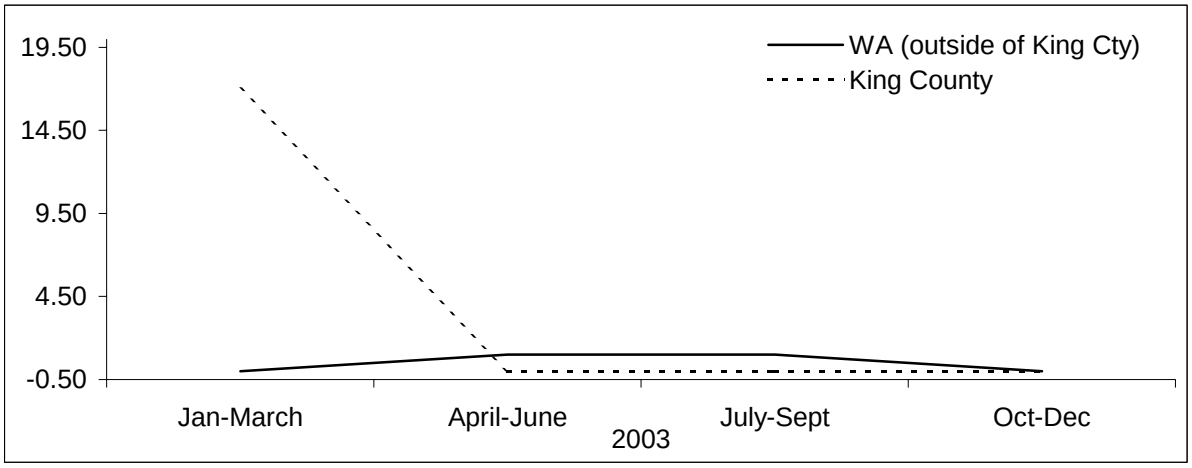
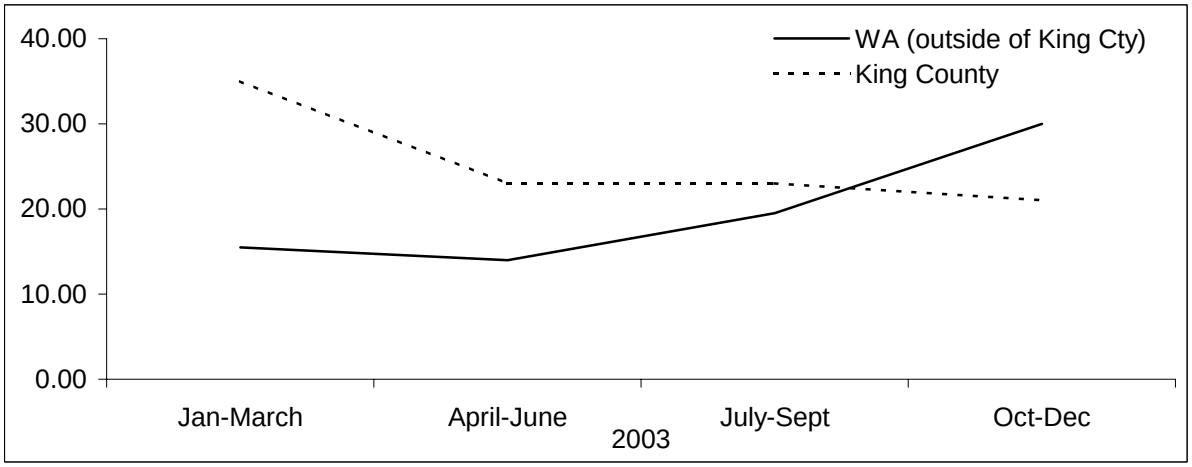


Figure 31 shows the time between the culture + date and when the susceptibility information was reported, King County reported a decrease in the number of days for 2003 while the rest of Washington State increased the number of days it took to report susceptibility information.

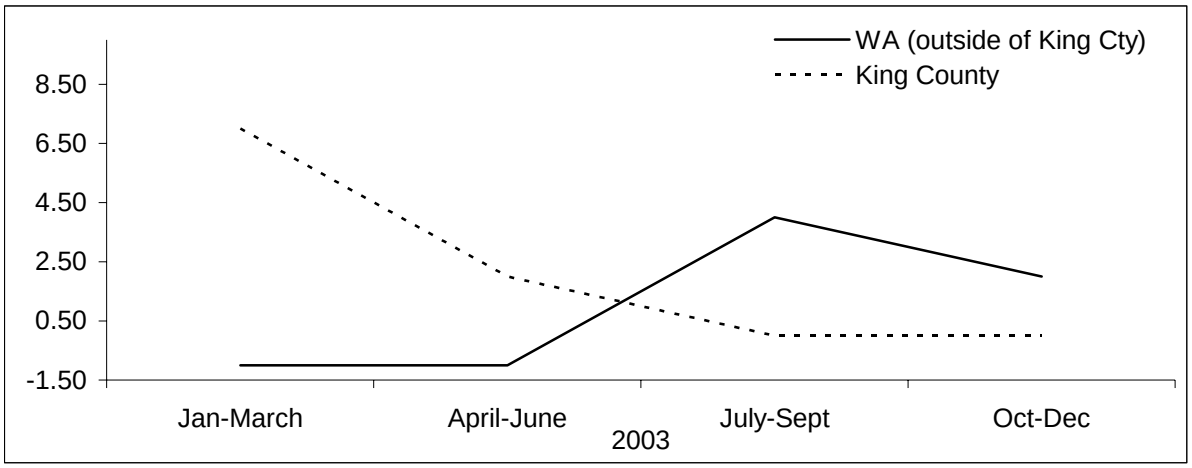
Figure 31
Median number of days between culture + date and when the susceptibility results were reported, Washington, 2003



Contact Measures

Figure 32 shows the number of days between the smear + result and when contacts were identified for the smear + case. For 2003, King County shows a steady decline in the number of days between the 2 dates while the rest of Washington State show a slight increase.

Figure 32
Median number of days between the smear + date and when contacts were identified for that case, Washington, 2003



CONCLUSION

The Washington State tuberculosis crude incidence rate decreased from 6.0 per 100,000 in 1992 to 3.9 per 100,000 in 2004--the lowest level ever. TB disproportionately affects persons ages 65 and over, who had higher case rates than any other age group (7.3 per 100,000). Over the last five years, persons classified as white maintained an incidence rate lower than the state rate, while persons among minority populations continue to be overrepresented in the TB data and have case rates higher than the state rate. Trends in the incidence rates of TB according to racial and ethnic characteristics show increases in case rates among blacks and American Indian/Alaskan Natives, while case rates among whites have remained stable. Ten-year trends among foreign-born populations indicate proportional increases in both case numbers and resistance, specifically to INH. The proportion of tuberculosis cases was low among persons living in residential or correctional facilities (4%) and among persons with HIV (4%). Also, drug resistance did not appear to be increasing in Washington State. There were only 30 cases that were resistant to any TB medicines in 2004 a slight increase since 2003. In addition, there were two cases of MDR-TB reported in 2004.

Priorities for Tuberculosis Control and Prevention

1. Case-Finding

Identify all active cases of TB and ensure completion of an adequate course of curative treatment.

2. Close Contacts

All close contacts of pulmonary cases should be identified, screened, placed on appropriate preventive therapy, if clinically indicated, and followed for therapy completion. National data and the CDC indicate that persons who are closely associated with persons who have active TB have a greater risk in not only becoming infected but also in developing disease within the first two years after infection.

3. Targeted Screening

- *Foreign-born* - The proportion of TB cases associated with persons born outside the United States continues to grow. In 2004, 67% of all cases were foreign-born. A focus on closing the gap between US-born and foreign-born populations is critical for future TB control efforts.

- *Persons with HIV/AIDS* - Compared to national data, Washington State has been fortunate not to have a significant amount of TB associated with AIDS and data from 1994-2003 suggests that although co-morbidity may be slightly increasing in recent years, this increase still reflects low case numbers. All HIV-infected persons should be evaluated for eligibility for antiretroviral therapy and should be screened and, if warranted, treated for latent TB infection.

- *Persons with other medical conditions* – Persons with other medical conditions (e.g., diabetes, organ transplant, other immunosuppression, end-stage renal disease) that predispose to TB acquisition or reactivation.

- *Marginalized Populations* - 14% of new cases in 2004 reported homelessness in the last 12 months. Two percent of TB cases indicated IV drug use in the past year, although this may be underreported. Targeted screening in theses groups could be effective if follow-up and adherence to therapy for latent infection can be assured.

- *Minority populations* – The TB incidence rates for blacks, Asians, American Indians and Hispanics are higher than that of whites and may be a reasonable surrogate marker for identifying a higher prevalence of infection, particularly when associated with a higher prevalence of risk factors in those groups. Caution is warranted for targeting populations based solely upon race and ethnicity.

Tuberculosis continues to deserve special attention in Washington State, despite recent declines. Excess cases reported in King County and increases in the number and proportion of cases attributable to persons born outside the United States, especially among recent arrivals, highlight the complexities and challenges of TB control. Cases in Washington State are concentrated in the urban centers of King, Pierce, Snohomish, Spokane, Yakima, and Clark counties, calling for a concentration of disease control resources in these areas. However, changes in demographics, populations, and immigration destinations may influence the incidence of TB in other counties of the state. Continued success in lowering TB rates calls for adequate resources at all levels to increase DOT coverage and completion of therapy for all cases of active disease, as well as to identify, screen, and treat recent foreign-born arrivals and other populations known to have a large burden of inactive TB or latent TB infection.

APPENDIX 1

OVERVIEW OF TB AMONG SEATTLE'S HOMELESS POPULATION, 2002 - 2004

TB Control Program – Updated January 2005

Outbreak History

Typically, there are 12 - 15 cases of active tuberculosis (TB) in homeless people in Seattle-King County. But over the course of 2002, the numbers mounted, resulting in a total of 30 cases of TB. The CDC and the Washington TB Control Office assisted the TB Program to create a plan to address the outbreak, and in February 2003, the TB Program started hiring medical and administrative staff specifically to work on the outbreak. In 2003, an additional 35 homeless people were diagnosed with active TB disease in Seattle and King County. In 2004, the numbers of active cases associated with the outbreak decreased substantially, with 11 diagnosed (23 total homeless diagnosed).

Community partners have worked hard with the TB Control Program throughout this outbreak. HCHN, Reach, Jail Health, Harborview, and staff at homeless service sites have been enormously helpful in searches and in offering additional information and insight on behaviors and patterns that help refine the approach.

Who are the homeless cases?

Table 12
Demographics among homeless TB cases by year case counted, King County, Washington State, 2000-2004

	Year Treatment Started				
	2000 (n=16) No. (%)	**2001** (n=12) No. (%)	**2002** (n=30) No. (%)	**2003** (n=35) No. (%)	**2004** (n=23) No. (%)
Gender					
Male	14 (88)	12 (100)	26 (87)	28 (80)	20 (87)
Female	2 (12)	0 (0)	4 (13)	7 (20)	3 (13)
Age Group					
0-4	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
5-14	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
15-24	0 (0)	0 (0)	0 (0)	2 (6)	7 (31)
25-44	7 (44)	4 (33)	16 (53)	15 (43)	6 (26)
45-64	9 (56)	7 (58)	14 (47)	16 (45)	9 (39)
65+	0 (0)	1 (9)	0 (0)	2 (6)	1 (4)
Race/Ethnicity					
White, non-Hispanic	10 (63)	8 (67)	3 (10)	8 (20)	3 (13)
Black, non-Hispanic	4 (25)	2 (16)	12 (40)	10 (31)	10 (44)
Hispanic, all races	0 (0)	0 (0)	3 (10)	3 (9)	1 (4)
Asian/Pacific Islander	0 (0)	1 (8)	1 (3)	0 (0)	1 (4)
American Indian/Alaska Native	2 (12)	1 (8)	11 (37)	14 (40)	8 (35)
US-born					
Yes	11 (69)	8 (67)	25 (83)	33 (94)	12 (52)
No	5 (31)	4 (33)	5 (17)	2 (6)	11 (48)
HIV Result					
Positive	3 (18)	3 (25)	9 (30)	2 (6)	0 (0)
Refused	1 (12)	0 (0)	1 (3)	0 (0)	3 (13)
Genotyping					
RFLP Match	0 (0)	0 (0)	17 (57)	27 (77)	11 (48)
Non-outbreak RFLP	1 (6)	10 (83)	13 (43)	7 (20)	10 (43)
Pending	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clinical Case	0 (0)	0 (0)	0 (0)	1 (3)	2 (9)
No RFLP done	15 (94)	2 (16)	0 (0)	0 (0)	0 (0)
American Indian RFLP match	N/A	0 (0)	9 (82)	13 (93)	7 (88)

How does the outbreak in 2004 compare to 2002 and 2003?

- The numbers of cases in 2002 were high; they grew in 2003, and appear to be dropping in 2004.
- In 2002, the rate of HIV was very high, but dropped significantly in 2003 and further in 2004, indicating that those who were HIV+ were first to contract TB, due to compromised immune systems.

- Proportionally large numbers of Native American people continue to be part of the outbreak. In 2004, there are smaller overall numbers, but a majority of Native American cases continue to match the outbreak strain, just as they were in 2003.
- Over half of the outbreak cases in 2004 were on the “hot list” of named or site contacts who were followed since December, 2002. All 6 had been screened negative for disease at least once during this period. Then, this year they developed active disease.
- Large numbers of the 2002 cases and 2003 cases had known, frequent ties to the Sobering Center and/or Chief Seattle Club, but in 2004, half of the cases did not. They were scattered elsewhere.

Why is the outbreak not over?

- Transmission of the outbreak strain is still taking place, as indicated by genotyping results.
- Many people were exposed to infectious people with active disease in 2002 and 2003, and many of those exposed acquired latent TB infection.
- Not all with latent TB infection have either started or finished treatment for latent infection.
- Many people have been exposed repeatedly to infectious people with active TB.
- The greatest probability of developing active TB disease from latent infection is in the first 2 years after infection, and we are still within the 2 year period for people infected during 2002 and 2003.
- Once people have to be indoors at homeless service sites during colder, wetter months, an increase in transmission may take place, so the rate of new cases will likely increase.

APPENDIX 2

OVERVIEW OF A TB OUTBREAK AMONG YOUNG EAST AFRICANS IN SEATTLE, 2004

TB Control Program – Updated January 2005

The diagnosis of TB in a young East African male in February 2004, followed by the hospitalization of a second East African case in early April with similar demographics, alerted TB case managers to the possibility of a cluster of cases. In the following few months, 3 more East African cases were diagnosed with TB. As of January 2005, 12 outbreak-associated patients with dates of diagnosis ranging from December 2003-September 2004 have been identified. Patients were mostly male, East African immigrants in their '20s, of Amharic, Eritrean, Ethiopian, Oromo, Somali, or Tigrinyan ancestry. Most had a combination of social risk factors such as drug use, incarceration history, and unemployment. All had pulmonary disease, and one was infected with HIV. Cases generally showed a very rapid progression to disease and overt TB symptoms, including cough and weight loss. All cases were either genotypically linked with a matching strain type or had an epidemiologic link to a patient with an isolate matching the outbreak pattern.

Table 13
Demographic characteristics of the East African outbreak, King County, Washington State, 2004

Disease Characteristics	No.
Culture-confirmed	11
Pulmonary disease	12
Cavitary	7
Sputum smear-positive for AFB	8
Symptomatic at diagnosis	10
HIV infection[1]	1
Patient Characteristics	
Male	10
East African origin	10
Foreign birth	9
Incarceration history	12
Recent victim of assault	7
Illicit drug use	12
Unemployed	12

[1] Note: Unknown for one patient

APPENDIX 3

BACKGROUND
Goals of Epidemiologic Profile

The goals of the Tuberculosis Epidemiologic Profile are:

1. **Describe in detail the distribution and determinants of TB in Washington;**
2. **Highlight disparities in disease incidence among sub-populations;**
3. **Provide temporal trends of tuberculosis;**
4. **Provide guidance to TB prevention, control, and policy development in Washington State.**

Data Sources

The following data sources have provided identification and management information of TB suspects and cases for the Tuberculosis Epidemiologic Profile:

- TB case reports from local health jurisdictions;
- State-sponsored nursing staff case management updates; and
- Public Health Laboratory specimen testing reports.

Terminology and definitions used in this report are explained in Appendix 3. A brief summary of the TB surveillance system and data quality and limitations can be found in Appendix 4. Readers are advised to review these appendices carefully to fully understand the complexities of the surveillance system and its impact on data quality.

Guidelines to Prevent Misuse of Data[4]

Ready access to data by persons unfamiliar with the sources or unacquainted with epidemiology and statistics sometimes leads to misinterpretation or misrepresentation of information. This could result in inappropriate decision-making and misdirection of resources. The following guidelines may help prevent data misuse and should always be considered when reviewing data from any source:

1. Understand what you are looking at. What do the data cover? Do the data represent TB infections or TB cases? Do the numbers reflect new (incident) cases or cumulative numbers of cases? Are trends presented appropriately, using the same criteria for the numerator and denominator over the period of investigation?

2. Know the limitations of the data source. How is the information collected? How accurate and complete are the data? Do the data represent the general population or just a very select subgroup?

3. Do not over interpret small changes. Small increases and decreases in numbers can look large if the baseline numbers are small to begin with. For example, if two cases of TB are counted in a particular county in one year and three cases are counted the next year this is an increase of 50%. This may sound significant, but a change of one case is not. Caution is warranted.

[4] Adapted from Washington State HIV/AIDS Epidemiologic Profile, page 8.

4. Look for consistencies with other sources of information. Results from an investigation are more believable if they are supported by similar findings from other known studies. This does not mean that new findings should be ignored, but they may deserve a little more attention in establishing their conclusions.

In summary, data should never be taken at surface value. They should be closely scrutinized, analyzed, and placed into context before any decisions are made.

APPENDIX 4

Terminology and Definitions

The intricacies of tuberculosis case identification and management require the reader to be familiar with some specific epidemiologic terms and surveillance criteria.

- Tuberculosis Suspect - Any person who reports clinical symptoms associated with TB, e.g. productive, prolonged cough, chest pain, hemoptysis, fever, chills, loss of appetite, or weight loss, and is evaluated by a medical practitioner for tuberculosis, which may include diagnostic X-rays and bacteriology collection, is considered a suspect. All practicing physicians are required by Washington State law to report all suspects of TB to their local health authorities immediately (WAC 246 -101-101); in turn, local health authorities are required to report these suspects within seven days to the state TB Control Program (WAC 246 -101- 510).

- Tuberculosis Case - The Centers for Disease Control and Prevention (CDC) has outlined two sets of case-defining criteria, laboratory confirmed and clinically confirmed (Table 12).[5] A person suspected of having TB must meet one of the two case definitions to be considered an active case. This report focuses on active tuberculosis cases.

Table 14
Tuberculosis case definition criteria

Laboratory Case Definition (*must meet ANY of the following criteria*)	**Clinical Case Definition** (*must meet ALL of the following criteria*)
• Isolation of *Mycobacterium tuberculosis* using culture techniques from a clinical specimen; OR • Demonstration of *Mycobacterium tuberculosis* from a clinical specimen by DNA probe or mycolic acid pattern on high-pressure liquid chromatography; OR • Demonstration of acid-fast bacilli in clinical specimen when a culture has not been or cannot be obtained in a patient with clinical symptoms of tuberculosis.	• Positive tuberculin skin test (negative test is allowed for those patients with proven anergy or an AIDS diagnosis); AND • Other signs and symptoms compatible with TB, such as an abnormal or unstable chest x-ray or clinical evidence of current disease; AND • X-ray improvement on chemotherapy; AND • Treatment with two or more anti-tuberculosis medications; AND • Completed diagnostic evaluation.

A relatively small number of TB cases dispersed among a large number of counties in Washington limits the ability to perform county-specific analyses. A minor disease outbreak, a clustering of cases, county demographics, and the effect of prison populations in several counties impact the measurement of this disease at the county level. The number of reported and counted cases within each county may not reflect all efforts of TB case management and control occurring within county jurisdictions. Cases that are reportable-but-not-countable may be under the supervision of local health

[5] Core Curriculum on Tuberculosis, Third Edition. Centers for Disease Control and Prevention. Atlanta, Georgia, 1994.

departments and receiving TB treatment, directly observed therapy, and case management but not included in the official counts for TB morbidity. When assessing true "burden of disease" on local health department infrastructure and resources, it may be necessary to assess the impact of cases that are reportable-but-not-countable in addition to the cases included in state morbidity totals.

- Active vs. Inactive - A distinction is made between active cases of TB and inactive cases of TB. Active cases have positive cultures for *Mycobacterium tuberculosis* or a positive tuberculin skin test and clinical or radiographic evidence of current disease. Active cases are often infectious. Inactive cases have a history of TB disease or abnormal but stable X-rays, positive tuberculin skin tests, negative bacteriologic evaluations, and no clinical evidence of current disease. Inactive cases are never infectious.

- Infected vs. Diseased - Persons who have positive tuberculin skin tests but no clinical or radiographic evidence of TB are considered infected. These persons are non-infectious and cannot transmit the tubercle bacillus. Diseased persons have met one of the case definition criteria. "Diseased," "active," and "TB case" are terms often used together and interchangeably to identify the population of persons known to have current disease.

- Counted Case vs. Reportable-But-Not-Countable - To avoid duplication, a case of TB is only counted by Washington State if another county, state, or country has not already counted the current episode of TB disease. Therefore, all new cases of TB for Washington were first identified as active TB in this state. Frequently, the state TB Program is notified of persons entering our state with TB for whom therapy and case management is required to be provided by local health jurisdictions. In this situation, these persons are classified as "Reportable but Not Countable," meaning the case must be reported to the CDC but was already counted by another locality. There are additional situations that make a person "Reportable but Not Countable" for TB.

  A case is "Reportable But Not Countable" if:
  (1) the case enters the United States with active TB and on treatment; OR
  (2) the case moved to Washington from another state or country after identification of tuberculosis, treatment started, and case reported in the originating state or country; OR
  (3) the case has been off therapy from a previous episode of TB disease for less than one year.

- Incidence - The number of new cases of disease, usually within a given time period. For example, in 2004, there were 244 new cases of TB; therefore, the incidence of TB was 244.

- Crude Incidence Rate[6] - The number of new cases per unit population for a given time period, usually a year. This calculation accounts for the size of the population. The following equation describes the crude incidence rate:

$$\text{Rate} = \frac{\text{Number of new cases in a population}}{\text{Number of people in the population}}$$

[6] Adapted from the Washington State HIV/AIDS Epidemiologic Profile. Department of Health, Office of Infectious Disease and Reproductive Health, Assessment Unit, 1996.

Rates are usually expressed in terms of cases per 100,000 population. Rate calculations allow for comparisons between populations by adjusting for the different sizes of the populations. Rates are not calculated for fewer than five cases in a population, including zero cases, because the calculated rate is unstable and exhibits wide confidence intervals.

Rates calculated from surveillance data are only as reliable as the surveillance system itself; if all cases of the disease measured are reported within the surveillance system, then the rate calculated is most likely the true rate in the population. However, if under-reporting of disease is suspected and cases are missed by the surveillance system, then the rate calculated using surveillance data may only estimate the true rate in the population.

- Denominator Data – Data from 2000 - 2005: Office of Financial Management, Washington State: Revised February 2005. Data from 1994 - 1999: Census of Population and Housing, 1990: MARS files of Washington State, U.S. Bureau of the Census 1990-1999. Analysis Software: SAS v8.2.1, SAS Institute, 2004.

- Confidence Interval - The confidence interval (CI) evaluates the influence of chance or random variability on the statistical estimate or rate (Selvin, 1996). Surveillance data, even based on complete counts, may be affected by chance. If variation in the occurrence of the disease is random and not affected by inconsistency in diagnosing or reporting, then confidence intervals may be calculated to facilitate comparisons over time or between geographic locations (e.g. counties). In this situation, calculated confidence intervals should be based on a Poisson probability distribution. In general, if confidence intervals for two separate rates overlap, there is no statistically significant difference between the two rates.

  Narrow confidence intervals for rates indicate with greater certainty that the calculated rate is a reliable approximation of the true rate, while wide confidence intervals signal greater variability and less certainty that the calculated rate is a good estimation of the true rate.

- Race - All suspects or cases of TB are categorized according to race. Race can be self-reported, extracted from the medical record, or visually assessed by clinical or administrative staff. One of four races must be indicated on the TB case report: White, Black, Asian/Pacific Islander, or American Indian/Alaska Native. Race is reported and counted separately from ethnicity. In 2003, race classifications changed to add a multi-race option. One case reported multi-race in 2004.

- Ethnicity - All suspects or cases of TB need to have Hispanic or non-Hispanic ethnicity indicated on the TB case report. Ethnicity can be self-reported, extracted from the medical record, or visually assessed by clinical or administrative staff. Ethnicity is reported and counted separately from race.

Foreign-born - The term foreign-born is applied to any person born outside the United States, American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Midway Island, Northern Mariana Islands, Puerto Rico, Republic of Palau, U.S. Minor Outlying Islands, U.S. Miscellaneous Pacific Islands, and U.S. Virgin Islands.

- The month and year that these persons entered the U.S. is recorded on the TB case report. It is important to note that even though these persons are born outside the United States, their duration of residence in the U.S. may be inaccurate or unknown.

- Multi-drug Resistant TB (MDR-TB) - Any case of TB that is found to be resistant to both isoniazid and rifampin, the two primary first-line antituberculosis medications, is defined as having MDR-TB.

APPENDIX 5

Tuberculosis Surveillance System

TB surveillance in Washington State incorporates both active case finding and passive case reporting. Through active case finding, the TB Control Program at the Department of Health is able to recognize potential suspects of TB in the early stages of the disease, expediting the patient's treatment and reducing the patient's infectious period. This is accomplished mainly by a direct computer link to the Washington State Public Health Laboratory whereby results of specimen testing for tuberculosis are received at DOH TB at the same time they are recorded at the laboratory.

The passive aspect of the TB surveillance system relies on providers of care to report potential TB suspects to authorities at their local health departments. The Washington Administrative Code requires all practicing physicians to report suspects of TB to the local health authorities immediately – updated and effective 12/23/2000 (WAC 246-101-101). Timely reporting of suspects and cases by practitioners allows local health authorities to monitor disease appropriately, perform contact tracing, and provide diagnostic expertise to those who may unwittingly be infected. Subsequently, county health departments are required to report these suspects within seven working days by submission of a case report to the state DOH TB (WAC 246-101-510). The case report is the primary data collection tool for tuberculosis. The data elements reported upon initial case notification include but are not limited to demographics, history of TB, bacteriology, site and therapy for current episode of TB, and risk factors. Additional data elements are continuously reported to the DOH TB throughout the management of the case at the county level. These are changes in address, bacteriology results, chest x-ray (CXR) results, and therapy regimens. During the management of the case, local health authorities are also responsible for directing and implementing a contact investigation and reporting the results of that investigation to the DOH TB. When a case has completed his/her course of therapy, determination of DOT status, completion and effectiveness of therapy, type of health care provider who managed the case, and reason for case closure are reported to the state.

DOH TB staff reviews all case reports for completeness as well as performs follow-ups on missing or incomplete data. Each case report is classified as not a case, suspect, or case. Suspects are continuously followed up by DOH TB staff until such time as they can be reclassified as cases or non-cases. Each week the TB Program counts the number of new, confirmed cases identified in each county in Washington. All surveillance information, except names, is subsequently reported to the CDC every Monday. The CDC compiles a national profile of TB for the purposes of accurately enumerating cases, monitoring adherence to recommended therapy protocols, calculating completion of therapy and directly observed therapy, and monitoring resistance to anti-tuberculosis medications.

Through the process of suspect reporting, determination of case status, and case counting, the true number of individuals with tuberculosis is confirmed and an accurate demographic, risk, and outcome profile of those persons can be outlined.

Data Quality and Limitations

The complex surveillance system for tuberculosis involves the efforts of many individuals at many levels of patient care and management at many times during the course of therapy, which can last more than a year. The data gathered and sent to DOH TB can have

variations in some of the elements reported, depending upon the interpretation of the data field by the person completing the TB case report, e.g. misclassification of persons in the wrong race or ethnic category. Ideally, data would be reported correctly and consistently by all parties involved but in any surveillance system this ideal is difficult to achieve. The data elements reported in the Tuberculosis Epidemiologic Profile are considered to be of high quality. In 2004, DOH TB initiated a data-cleaning program and began reviewing cases counted in 2002. Data quality checks for the future include quarterly reports that will be generated on cases with missing or incorrect data. The cases will then be investigated and their data revised. It is hoped that this new quality improvement mechanism will reduce the number of questionable data elements.